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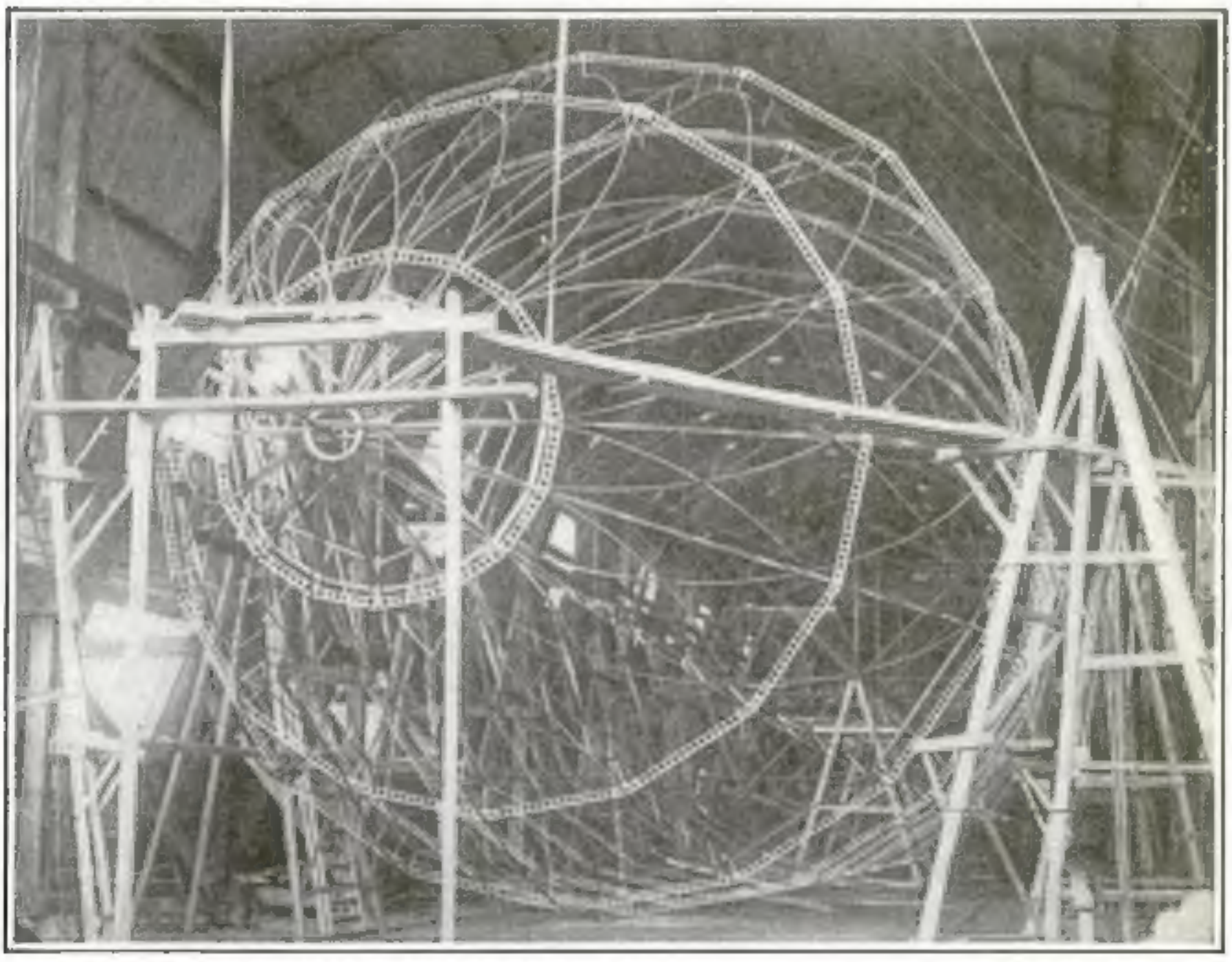
A Pigmy Zeppelin

A PIGMY Zeppelin (pigmy as Zeppelins go) with a basket-work frame of layered wood has been recently built for the British Government by a number of American constructors, including T. Rutherford MacMechen, president of the Aeronautical Society of America, and Walter Kamp, a prominent American aeronautical designer.

One of the chief efforts of the designer has been to reduce the weight of the hull and car without sacrificing strength, and this has been accomplished, he believes, by the substitution of laminated wood for the aluminum which composes the framework of the Zeppelin. The rings which are used to keep the hull in cylindrical form are made of thirty-nine thin layers of mahogany, carefully glued together, and covered by a steel collar. Thirty-two wooden ropes, hardly as thick as a man's thumb, wind again and again around the hull, weaving the whole



A pigmy Zeppelin which is being built for the British Government by a company of American constructors. The framework of this novel airship is made of ropes and laminated wood, so closely woven together as to resemble a huge mesh of wood and wire

into a great mesh of basket-work. Sixteen slender members form the longitudinals, running from bow to stern, and intersecting the spirals of wooden rope where they cross each other. The function of the spirals and longitudinals acting together is to distribute the gas lift and strains evenly to all points of the hull.

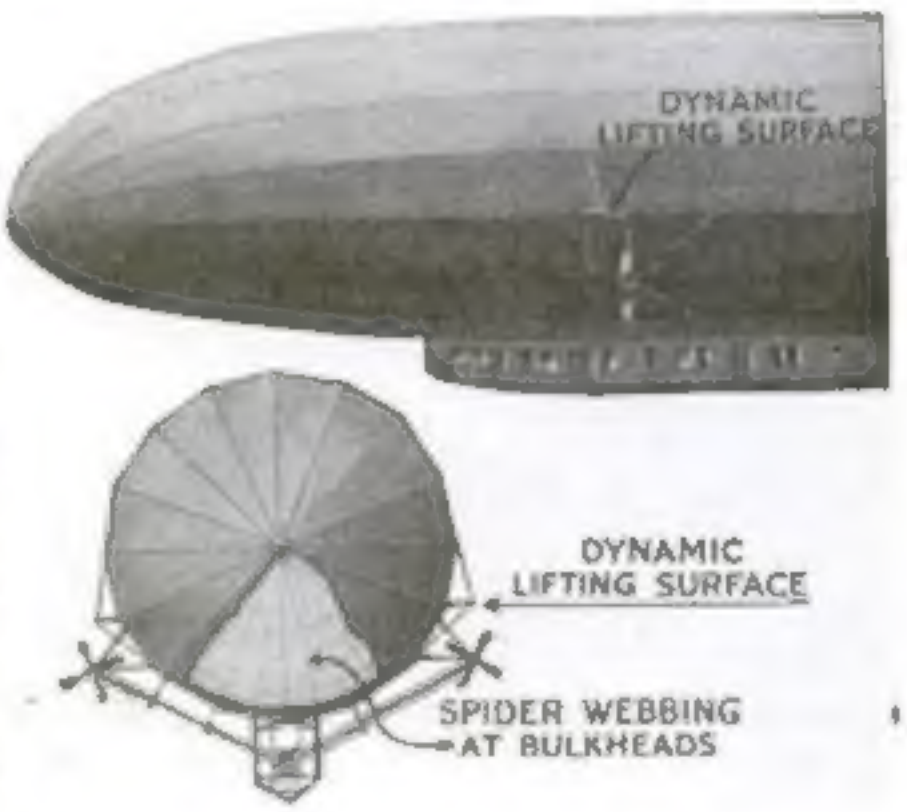
There are, in reality, two hulls, the inner enclosing thirteen balloonets or gas bags and the outer supporting a waterproof and airtight envelope or skin. Twenty-nine ribs, or transverse girders, encircle the inner hull, and a spider web of wire cables stiffens the alternate ribs and forms the bulkheads between the balloonets.

Two eight-cylinder, sixty-horsepower motors have been installed, and by means of cable drives transmit the power to four propellers mounted high above the car, two being placed on each side of the slender torpedo-like hull.

In hot weather, or when the airship passes through a heated stratum of air, the gas expands, exerting more lifting power, and causing the airship to rise. To control this tendency, the gas has to be artificially cooled, or it will be necessary to release some of the valuable hydrogen to allow the ship to retake its proper altitude. On the contrary, if a sudden wave of cold air strikes the gas bag, the gas immediately contracts, and part of its lifting power is lost. If there is no means for heating the gas and expanding it, ballast will have to be dropped from the car, thus compensating the decreased lifting power of the gas by a lighter weight which it has to carry.

The control of the lifting power of the gas in the MacMechen dirigible is in the heating and cooling process. To keep the hydrogen from cooling and losing its lifting power, hot vapor from the engine is blown into the foot-wide space between the balloonets and the outer skin of airtight cloth. To cool and condense the gas for descent, or to prevent its expansion to an extent that causes an undue inflation of the gas bags, cold air is introduced into the same space by means of a luminum disks with revolving shutters at the bow and stern.

It is claimed that by this method of construction a rigid airship has been built which is one-third lighter than it is possible to build a Zeppelin of the same relative size. The hull and car weigh 2,190 pounds, and the gas capacity is 108,000 cubic feet, or about one-tenth that of the latest Zeppelin monster. As hydrogen is usually rated by aeronauts, this quantity will lift about three and one-half tons, or seven thousand pounds. With engine equipment and crew, the airship weighs about 5,300 pounds, leaving a margin of 1,800 pounds for ballast, explosives and additional fuel. The length of the hull is 236 feet over all. The designers claim that their airship



will make about seventy miles an hour, or about ten miles an hour faster than the speed of a Zeppelin.

The Popular Science Monthly believes that this airship will prove disappointing to its builders and to the British Government. Previous experiments with wooden frames in dirigibles have proved costly failures. The Zeppelin's first rival, the Schütte-Lanz dirigible, was built with wooden framework, and proved much heavier than a Zeppelin of the same dimensions. Laminated wood was used in the experiment and this was found faulty and discarded. The Zeppelin of to-day is the product of practical experience, as is the second, and successful, Schütte-Lanz, which discarded the weblike wooden frame for the lighter metal ribs and strakes of the Zeppelin. Such a solid frame as that of the pigmy airship would not do for a

larger dirigible, for it loses the greater lightness for the same strength of a small structure. In a small dirigible resistance against propulsion is so much greater than the lift available for engine power in the large craft, that it completely discounts the small craft's structural advantages. Any improvements in lightness and strength will, therefore, never make this pigmy Zeppelin a superior in speed to its larger and more powerful rival.

The whole idea of a small and speedy "aerial destroyer" is mistaken, since in a dirigible everything has to take second place to speed; otherwise Zeppelins, which cannot seek safety in landing, would be at the mercy of the wind.

The rope drive to the propellers has been proved greatly inferior to bevel gearing, chains and belts. The cable drive was tested on the first Gross-Basenach, but was quickly discarded.

The most meritorious feature of the design of the pigmy Zeppelin is in the alternate heating and cooling of the gases by hot vapor from the engine and cool air sucked in by blowers. This certainly should prove of valuable assistance to the dynamic lift-control without entailing much additional weight.

In conclusion, it seems that the idea of a wooden frame has been tried, approximately in its present form, and found lacking. The rope drive has been succeeded by more efficient means of power transmission, and the entire trend of dirigible construction has been to increase the lifting power, and consequently the size, in order to achieve greater power and speed. Whether the Zeppelin has been a success or not is a mooted point, but the Zeppelin has been the only dirigible that has accomplished anything of note in this war, and the smaller dirigibles have been permanently relegated to their hangars.

13 DRUMS OF HYDROGEN GAS KEEP THE CRAFT ALOFT

The designers believe that the laminated wood construction will produce an airship which is one-third lighter than a Zeppelin could be built with similar dimensions. Two sixty-horsepower motors drive four propellers, and the airship will be expected to make more than seventy miles an hour at full speed

A Barbed-Wire-Proof Fabric

ONE of the most trying tasks incident to trench fighting has been considerably lightened by the appearance in the British trenches of gloves made of a fabric which is said to be impervious to barbed-wire points. The fabric is made up into mittens, with the first finger and thumb separate. The fabric is waterproof, and in addition the gloves are insulated for gripping electrically-charged wires.

The same material is applied to the manufacture of sleeping-bags, which, when opened, may be thrown over a barbed-wire entanglement to allow a soldier to climb over the sharp points without injury. When made up into vests or tunics, the fabric is strong enough to turn shrapnel splinters, or even a bullet when it has lost part of its momentum. The interlining is antisepticized, so that if a bullet goes through, it takes into the wound enough antiseptic wool to prevent poisoning.

The materials used in the manufacture of this remarkable fabric have been sedulously kept secret this far.

Preserving Indian Speech

WE are already beginning to regret that no phonographic records could have been made of the voices of great singers of the last generation, while we shall be handing down our Carusos and Melbas to those who come long after us. Not long ago the Department of the Interior in Washington awoke to the fact that there was something else to be preserved for the future, namely the speech and war songs of our native Indians. The new generation of Carlisle-bred chiefs do not take the ancient rituals very seriously, and it is probable that after the oldest of the living warriors have died, the Indian war songs will be practically forgotten.

A chief of the Blackfeet singing his war songs into a Government phonograph for preservation

It was this feeling which prompted the Government to make the phonographic records of the voices of the greatest of the living chiefs for the files of the nation. For some time past, now, these warriors on their periodic visits to Washington have recorded on the phonograph their songs and their legends for the files of the nation.

A Rowing-Bath

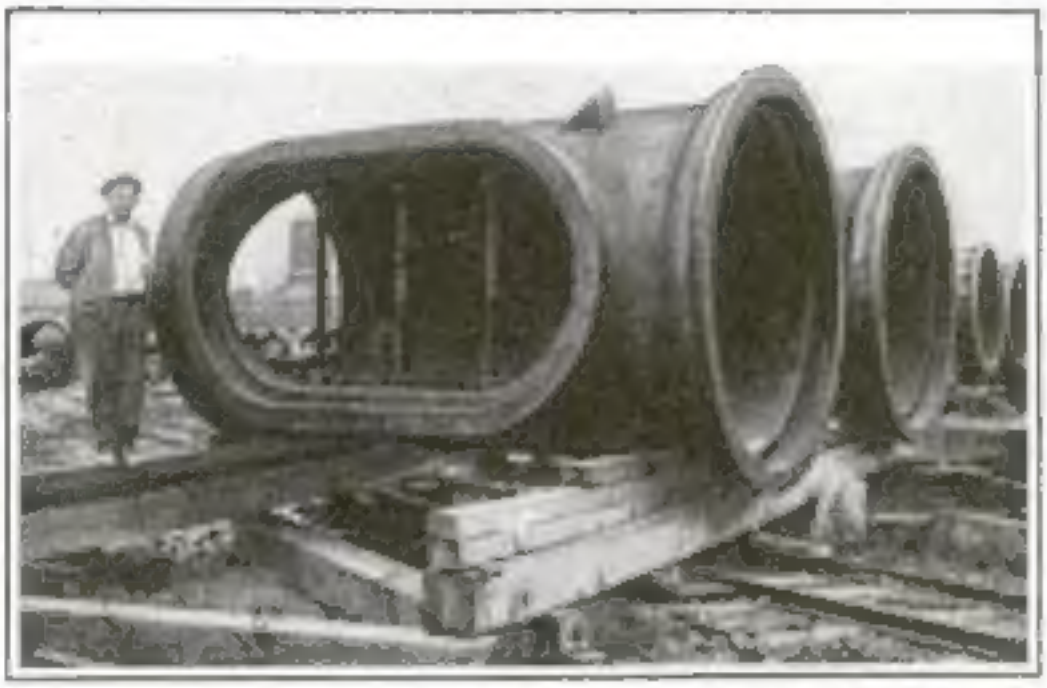
THE rowing-bath has been perfected in a western sanitarium for the purpose of adding zest to the morning plunge. It is valuable as a curative measure, but it may also be used with enjoyment and benefit by any one.

The rowing-bath consists of a metal container which is attached to the nozzle of an ordinary tub by means of a rubber cord sufficiently strong to give the element of exercise. Entering the tub, the bather attaches the rowing device and turns on the cold water. As it pours into the tub he scoops up the water and, pulling the container toward him with a rowing motion, empties it full upon his breast, thus securing the zest which accompanies the pleasant pastime of buffeting surf. This bath is a diversion from the ordinary "shower" on a hot summer day.

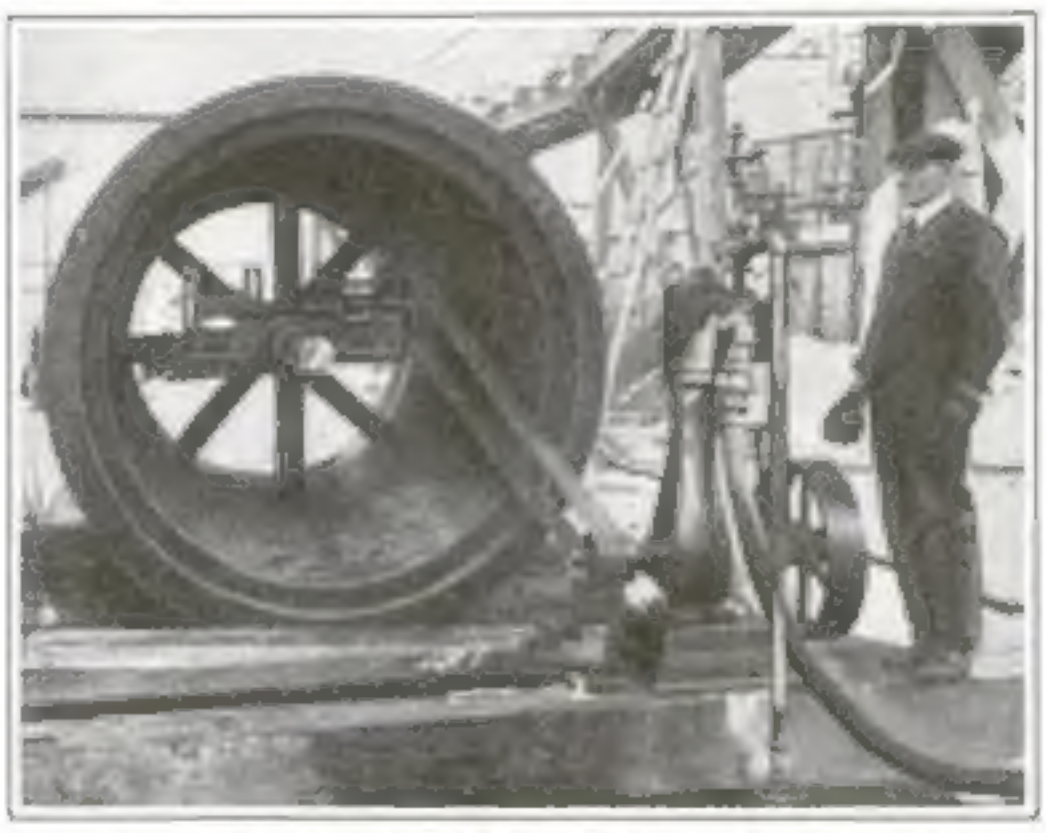
The rowboat bath is the newest contribution to the physical enjoyment of living

Biggest Cast-iron Pipes in the World

THE big gas-mains in the Astoria-Bronx Tunnel at New York are probably the largest cast-iron pipes ever made. The internal diameter is six feet; the thickness of metal is two and three-quarter inches; and the length twelve feet. The one end has the ordinary bell form; the other the spigot. The weight of one length is about twenty-six thousand pounds.



A row of seventy-two-inch pipes for the Astoria line, New York city. In the foreground is a spigot joint with tee cut-off



The small motor is driving eight steel knives which are cutting the pipe from the inside

These mains are laid parallel and run down a shaft at Astoria on Long Island, along a tunnel two hundred and twenty-five feet below the surface, under East River, and then up a second shaft at One Hundred and Thirty-second Street and East River. They are to carry gas into the Bronx, the most rapidly growing borough of New York city.

It is not an impossibility that the tunnel may sometime be flooded with water. Under such circumstances it would not be desirable to have the long lines of iron tubes begin to float. While the pipes are heavy enough to prevent their floating, the margin is not great. The weight of water displaced by a cylinder twelve feet long and seventy-seven and one-half inches in diameter is between twenty-four thousand and twenty-five thousand pounds. The overlap where bell-end encompasses spigot-end complicates the matter a little, but after all allowances are made, there would probably be a good solid weight to the pipe lines if the tunnel were full of water.

The amount of lead used to calk the joints is about two hundred and twenty-five pounds per joint. The mains rest on concrete saddles set six feet apart.

In order to reduce his unloading time and also to run coal into cellars as awkwardly placed as thia, a coal-merchant had a special truck body designed like that shown here

Small Motor Trucks Deliver Coal Cheaply

SAVING time by means of a dumping body elevated by power from its own motor and skids laid over the sidewalk, the small two-ton truck shown in the accompanying illustration delivered an average on thirty tons per day for a period of several months and in doing so covered between fifty and sixty miles daily. At two tons per load this means fifteen trips per ten-hour day with an average length of trip of three to four miles.

In large cities, where streets are well paved, the coal delivered in large quantities and the hauls more than five miles, five- to ten-ton trucks have proved very successful. But for country and suburban work, where the roads are poorer, the coal delivered in five-ton loads or less and the hauls less than five miles, trucks of two-tons capacity or thereabouts have proved best.

For work in residence sections where the streets are soft, small-capacity trucks can maneuver more quickly than larger ones, run less chance of getting mired, and because of their greater speed, can often deliver a greater tonnage.

A Man-Power Reel for Hauling in a Long Seine

AN ingenious device for hauling in a long seine has been introduced by a fisherman who operates on a large scale in Mississippi. The seine he uses is over a mile in length, and it would require a large crew to haul it in. The contrivance he has invented consists of two wheels about eight feet in diameter, mounted on the ends of an axle, thus forming a huge reel. This is mounted on a scow so that it can revolve. The seine is wound up on the big reel.

The fisherman winds up his mile-long seine on a big windlass which a small crew can operate by hand in a moderate-sized boat

When it is to be laid, the scow is rowed out to the desired spot, the end of the seine is fastened to a stake, which is driven to the bottom, and the seine is paid out from the reel as the scow is rowed away from the stake. A man at each wheel tends the seine to keep it from tangling. To haul it in, two of the crew tread up the spokes of the wheels so that the reel revolves and slowly rolls up the seine on the axle, the scow meanwhile being backed over the course of the laid seine. Negro labor is cheap in the far South, so that this device has proved both economical and efficient.

THIRTY-FOUR dollars a minute is the cost of maintaining New York's police force of nearly eleven thousand men.

Saves Work of the Book Gatherer

THE gathering or assembling of a book in the book bindery is generally done by girls who walk around a large room taking the signatures from one pile after another as they move along. The work is hard and the capacity of the gatherer is limited by her walking ability. Where the character of the work is always the same, special machinery has been made which will do the work, but where there is a variety of work the human gatherer is necessarily resorted to.

An electric table driven by a two-horse-power motor has recently been designed and built by the manager of a Louisville printing establishment which enables the girls to sit at their work, taking the desired sheets from the piles placed on the table as they move by in an endless procession. The table will accommodate ten or twelve girls. It was successfully used in the assembling of a two-thousand-nine-hundred-page legal work, and it is claimed by the inventor that by making the table a double-decker, an unabridged dictionary could be handled upon it, so efficient is the rotating arrangement.

The center of the table revolves and the girls pick off the printed units they are gathering for binding

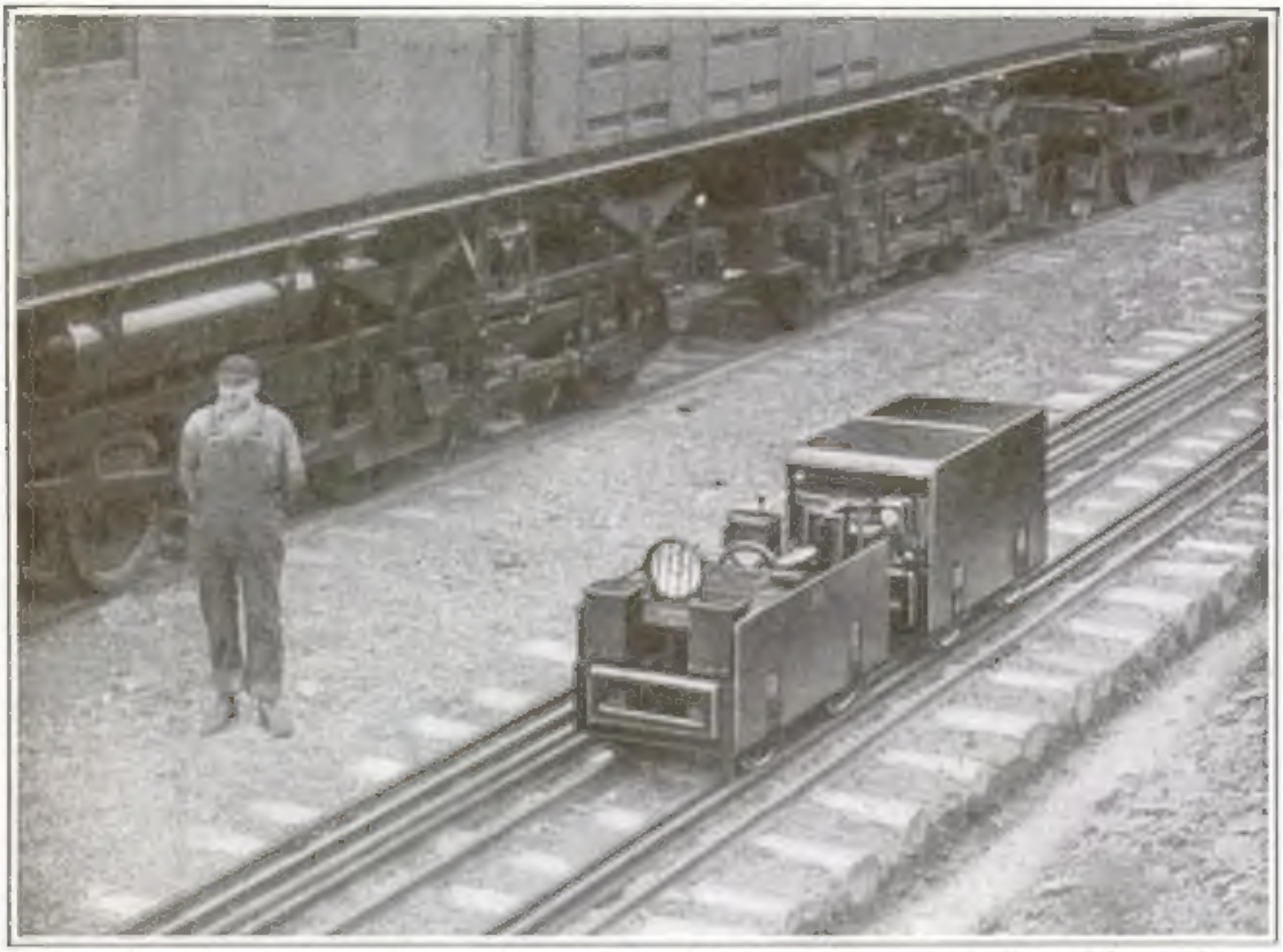
A California fireplace where everyone can sit in front of the blaze, but which has no inglenooks

A "Center-of-the-Room" Fireplace

A BUILDER of Long Beach, California, has constructed a novel fireplace in his home, the very lines of which have the effect of making this dwelling "different." This is a "middle-of-the-room" fireplace and is known as a brazier. It is possible for a family and its friends to sit entirely around the fire, so that a dozen or more persons may toast their toes at the same time.

The brazier consists of a hood, a basin, a spark-guard and a grate. With the exception of the grate, the parts are made of hammered copper. The basin, the sides of which serve as a foot-rest, is five feet square, six inches deep and four inches from the floor, and is supported by four legs, located at the corners. Within this basin an iron grate has been placed, on which the fire is made, only the ashes falling to the basin. A copper-wire spark-screen, three feet in height, has been made to fit within the basin at the foot of the sloping sides. This guard has brass posts, top and bottom. It may be instantly removed when it is desired to clean the basin.

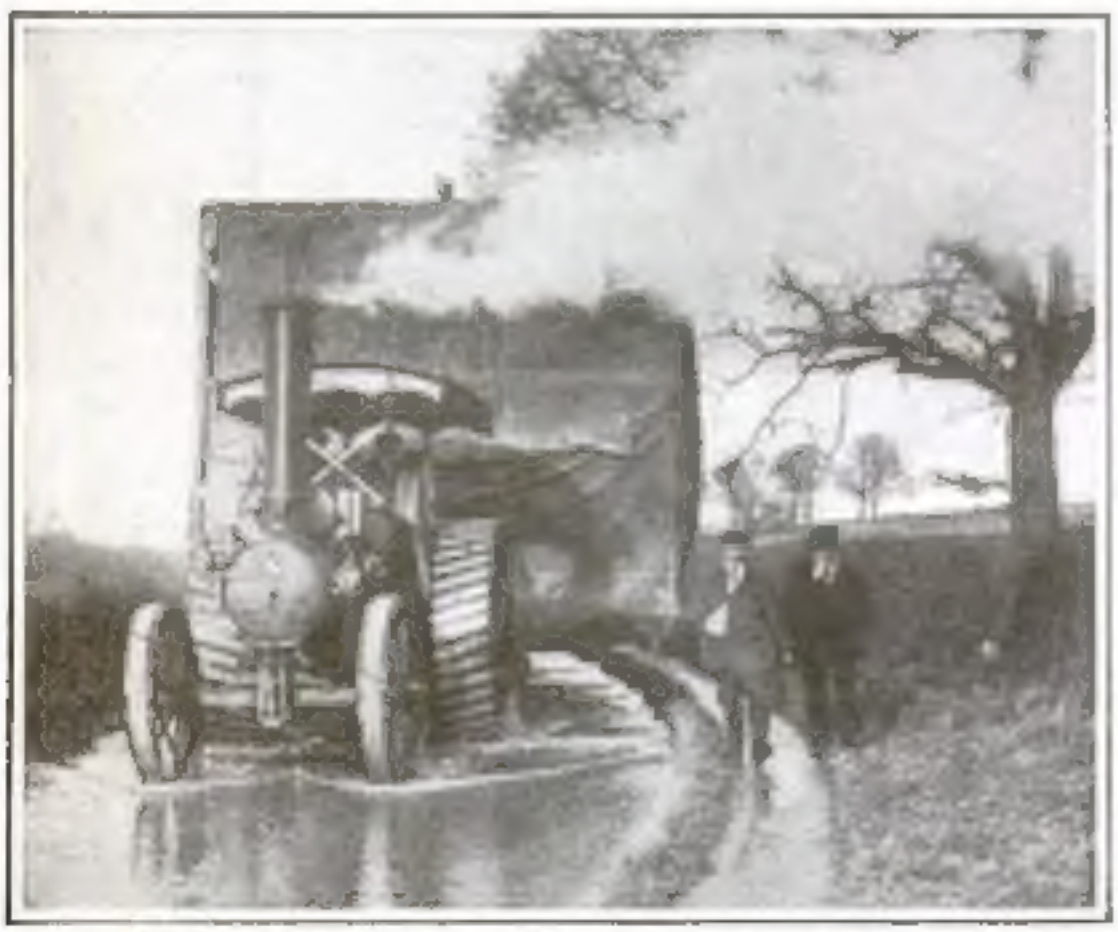
This home has walls nine feet in height and it is of such a length so that when lowered its upper end extends a foot or so above the ceiling. The neck of this hood is twelve inches wide. At its lower end it flares out to four feet.



The tiny electric locomotive on the small track is as mighty, weight for weight, as the giant which fills the background

Not a Toy—A Real Locomotive

THE engineer is standing next to the largest electric locomotive in the world. But the youngster in the foreground is not a top by any means; it is a lusty, able, mining locomotive weighing five thousand pounds. Pound for pound and volt for volt, it can draw just as heavy a load as its big brother behind, which weighs five hundred and sixty thousand pounds. The big motor is driven by a current of three thousand volts, while the "toy" which runs on a twenty-inch gage track, is driven by a self-contained storage-battery, delivering eighty-five volts.



A British army tractor which crossed England despite many difficulties

A Difficult Journey for an Army Tractor

WAR certainly gives rise to strange exigencies. In the illustration may be seen a big tractor transporting a large, awkward load through a flooded road in Berkshire, England. Difficulties were encountered every mile. Telegraph wires were always in the way, tree branches seemed surprisingly numerous, and arches reared themselves in the path of the vehicle.

Dumping a Whole Carload of Coal at a Time

THE speediest way of loading coal from a freight-car into a steamer is embodied in a mechanical loading plant installed on a wharf at Charleston, South Carolina.

Instead of unloading the coal from the cars and stacking it to await the steamer, then retransporting it to the steamer's hold, the car, filled with coal, is merely lifted bodily from the track by a powerful elevating mechanism and its contents poured into a great chute, from which it streams into the hold.

This giant coals steamers and loads barges by picking up railway cars and turning them upside down over the hopper

Thirty coal-cars, each with a load of one hundred tons, can be handled in an hour. The entire plant is electrically operated. In action, the electrical loader is spectacular. The loaded cars roll down an incline upon the elevator. A motor is started, the car swings upward until it is turned bottom-side-up, the coal pouring into the hopper, thence to the ship.

Machine Fills Cracks in Pavement

FILLING in the cracks between paving-stones is a process known as "grouting," and proper grouting, when done by hand with the aid of a wheelbarrow and a trowel or a spade, is a slow and time-consuming task. A compact grouting-machine has been brought out, which, while operated by only one man, is able to do the work better and in less time than a small gang of laborers. A concrete-mixing machine is mounted on wheels with a long spout protruding in front. As the concrete is needed, it is poured through the spout and out upon the pavement, whence the cement finds its way into the cracks.

A machine which fills in the cracks between paving stones

© American Press Association

The "Cascadas" is the largest all-steel dredge in the world. It scoops up fifteen wagon-loads of material at a time, and has disposed of as many as seventeen thousand wagon-loads of earth and rocks in a single day

Digging Away the Slides at Panama

THE whole Panama Canal zone may be imagined as an aggregation of slopes of hard material upon which softer materials rest. In cutting the canal the equilibrium maintained between the upper and the lower strata was disturbed. As a result the overlying material tobogganed down into the cut which constitutes the canal, upon the inclined under material. Nothing can stop the movement now in progress until the angle of repose is attained, and this can be reached only by removing the excess amount of material. Col. Goethals states that seven million cubic yards must be removed before the slides are entirely stopped, and that this is at best only a guess. "It must not be inferred," says Col. Goethals, "that the canal will be closed until this amount is dredged; on the contrary, it is the intention to pass ships as soon as a channel is secured through the remaining six hundred feet, and there are reasonable grounds for as-

The thousands of tons of earth and rock precipitated into the Panama Canal had to be removed before shipping could pass through the canal. Two dredges and the ship "Newton" were caught at this point. It took seventy-nine days to dig the "Newton" out

suming that a channel through the obstructed area can be maintained."

Seven dredges have been more or less steadily working at the bases of the Culebra slides for the last few months. Three of these are fifteen-yard dipper-dredges, one is a five-yard dipper-dredge, one a ladder-dredge and the others are sea-going suction and pipe-line suction-dredges.

The two photographs appearing on these pages show the fifteen-yard dipper-dredge *Cascadas* at work. This is the largest all-steel dredge in the world. It was made in Germany especially for use in the canal and was shipped in parts to the Zone. The dredge is one hundred and forty-four feet long. The bucket shown in the picture lifts fifteen wagon-loads of material at a time. In a single day fourteen thousand cubic yards—in other words as many wagon-loads—can be removed, although a record of seventeen thousand cubic yards has been made.

The May Popular Science Monthly will be on sale Saturday, April fifteenth (West of the Rockies, Saturday, April twenty-second).

Roller-skates have been found successful in Baltimore as a means of speeding up the message boys in telegraph offices where a great volume of messages is relayed

Roller-Skates in Business

DURING the rush hours, when telegraph operators are busiest, Western Union boys glide on roller-skates from desk to desk, snatching the messages from the hooks without even stopping, and scarcely slackening their speed. The boys and operators co-operate in the ratio of about one to twenty-two. That is, with one boy for every twenty-two operators, the messages are not allowed to stay on their hooks more than one second before being snapped up.

The skates are fitted with rubber rollers, so that another feature of modern business efficiency—silence—has been considered. Every second is scored down in black and white on the telegrams, and efficiency experts study these figures in an attempt to cut down the seconds to fractions of seconds. The use of skates reduces the time according to the space which has to be covered. The main office in Baltimore has five boys who work in shifts, two being able to handle the work of forty-five of the swiftest operators. The room is sixty feet long and accomodates many operators.

Best of all, the boys enjoy their work.

Motor-cycle Helps Light a Town

WHEN the town of St. Charles, Mo., was left in darkness recently by the breaking of the high-powered transmission cable from the Keokuk dam on the Mississippi, a motor-cycle helped save the situation and keep the town lighted. The town formerly was lighted by a steam-power plant which drove a 150 k.w. generator. When the engineers looked up the abandoned steam plant they found it possible to get up steam and run the generator, but discovered that an important auxiliary, the little exciter-generator which is run in conjunction with the big one was out of commission. The exciter at the sub-station was available and E. F. Wayee, trouble man for the Electric Company of Missouri, harnessed his motor-cycle to the plant by removing the rear tire and belting the wheel to the exciter. For an hour, the motor-cycle supplied light to the city.

A motor-cycle attached to an electric light plant helped to light a town

Suspension Bridges of Wire Fencing

SUSPENSION footbridges have been built by a wire agency in Southern Oregon, to the number of twenty in Jackson County alone, which goes to show their practicability.

The method of construction is simple. Three lengths of fence are used. Two are stretched for the sides and one horizontal length serves for the bottom. After having been wired together and planked, the bridge is safe even for small children. The anchor posts must be well braced and put deep in concrete with long cross-pieces on the bottoms. The ends of the wires are wrapped around the posts and spliced to the wires again, so that there is no danger of their slipping, even though the staples may give way.

The bridge shown in the photograph is three hundred and ninety-six feet long; the longest span being two hundred and fifty-six feet. At the highest point it is forty-five feet from the water. The total tensile strength of the wires is seventy-five thousand eight hundred and eighty pounds, so that it will safely hold a load of a hundred people. The agency plans to build a one-hundred-foot wagon bridge in the near future along the same lines of construction.

Suspension bridge built of fence wire

A Cheap Way of Preserving Eggs

EGGS may be successfully preserved for many months in a solution of water-glass. One quart of water-glass, which may be purchased from any druggist for twenty-five cents, is enough to preserve twenty dozen eggs. Heat ten quarts of water to the boiling point and allow it to cool. Pour the water into a five-gallon earthenware crock, add one quart of water-glass and mix the two. Place the eggs in this solution as soon as laid, but do not wash them. When the crock is filled to within two inches of the top of the liquid, cover and store in a cool, dry place.

A gigantic granite statue is to stand in Washington—a monument to the heroes of the "Titanic"

To the "Titanic" Heroes

A COLOSSAL statue to the men who died on the "Titanic" that women and children might be saved first, is soon to be unveiled in Potomac Park, Washington. The statue, fifteen feet high, is the work of Mrs. Harry Payne Whitney, and is carved in granite. It was put in the stone at Quincy, Mass., and shipped from there to Washington for the unveiling.

The stark simplicity of the whole design, and the reach of the arms, which the artist consciously exaggerated, make the statue one which will be seen and remembered. Mrs. Whitney recently gave an exhibit of her work, the original design of this statue being the center of attraction.

The Lively Bird on Our Cover

KANSAS CITY was recently treated to the unusual sight of a spirited race between a young ostrich and a motor-cycle, when a policeman attached to the motor-cycle squad of the city police force paced the bird nearly a mile and a half on Cliff Drive, one of the fashionable thoroughfares of the city.

The bird is seven months old. Specially trained for such work, it has appeared in numerous state fairs in races with automobiles and motor-cycles. The policeman, although he could have easily made a speed of seventy miles an hour with his high-powered machine, paced the ostrich. His speed indicator showed that the bird made forty miles an hour. When near the finish line, the policeman brought cheers from the crowd which had gathered to witness the race by opening the throttle of his engine and finishing well in advance of nature's fastest bird at a whirlwind speed of over a mile a minute, to the dismay of the ostrich.

For part of the race, the motor-cycle kept just ahead of the ostrich, both bird and machine making a speed of forty miles an hour

The new safety hair-cutter by means of which you can trim your own locks

Every Man His Own Hair Cutter

CONSIDERING the success that has accompanied the wide use of the safety razor in its various forms, the advent of a new honed barber tool, the safety hair-cutter, leaves no reason now why every man should not become his own barber. The new safety hair-cutter is operated on practically the same principle as the safety razor, the main difference being that a comb takes the place of the steel guard. Holding the comb close to the head results in a close cut; holding it at a wider angle, in a longer cut. It is possible, if the comb is manipulated properly, to cut the hair nearly as close as if a razor were used, although the manufacturers advocate the use of a safety razor behind the ears and along the back of the neck.

Lawn Leveling

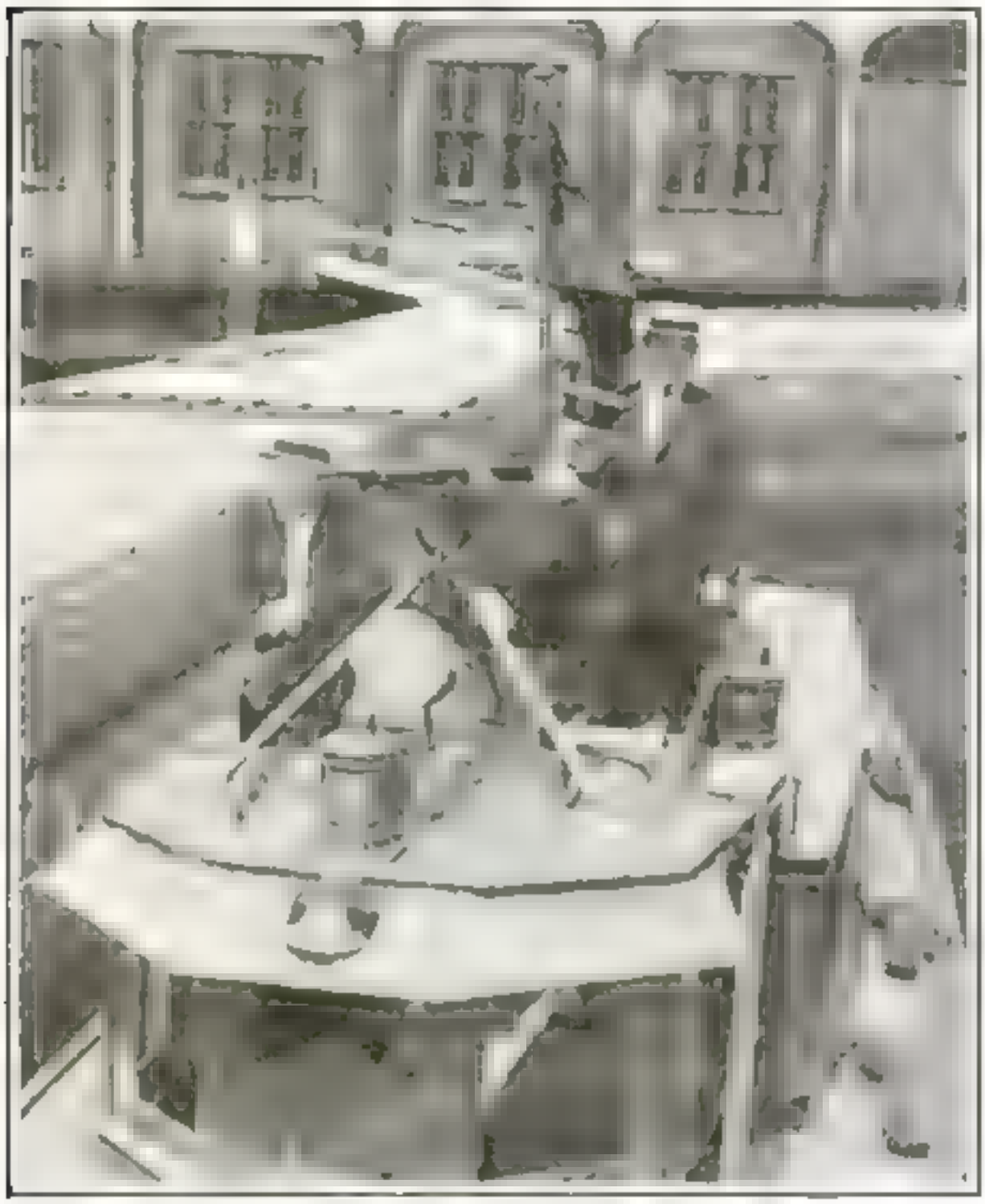
TO enable one man to level a lawn, set up in the center of the lawn a "plane table." Use a drawing board supported perfectly level on three stakes and about four feet from the ground. To test the height of the leveling pins as driven, tie a knot in a plumb line, so that when the knot is on a level with the board, the end of the bob is on a level with the required height of the lawn. It is then easy, no matter where the man is working, to sight along the level board and test the height of the stakes with the line. This method saves accumulating errors when carrying the levels out from one peg to another.

Making Throat Examination Behind a Glass Screen

ONE of the newest medical appliances to be placed at the disposal of physicians is an instrument which combines a device for holding down the tongue of a patient during an examination of the throat, and a circular glass shield, as shown in the illustration.

The glass shield is interposed between the face of the doctor and the mouth of the patient, and allows the doctor to make a much closer examination of the mouth and throat, than is now convenient. It is often necessary to swab out the throat with a solution which irritates the delicate mucous membrane and nerves, causing the patient to cough suddenly and violently, right in the face of the physician. Every physician will welcome this apparatus, especially for the treatment of diphtheria.

The device combines a spoon to hold down the tongue and a circular glass shield through which the physician looks at the patient's throat



Only Hong Kong surpasses New York in the number and activity of its harbor pirates. New York's police boats are therefore armed with machine guns

Taming Those Harbor Pirates

THE problem of the harbor pirate has perplexed the police of every great port of the world. Perhaps they have been more notorious in the cities of the Chinese coast than any other part of the world because of the wantonness and the dare-deviltry of their attacks. Even now in the port of Hong Kong which usually bristles with the warships of all nations, a dark, ghostly junk often slips quietly up out of the night. Throat-cutting and loot occur before the unsuspecting crew is hardly aware of the attack. Armored, shallow-draft gun-boats have done away to a large extent with these cut-throats in the south of China.

Next in prominence to the Chinese ports is the harbor of New York. It would be difficult indeed to estimate the number of cheap melodramas that have been based on New York harbor piracy. Within the last few years, however, the vocation of pirate in New York waters has lost the greatest part of its profitableness. River pirates when caught are dealt with so harshly that the pirates have been discouraged, and the recent addition to the New York police boats of automatic rifles, or gatling guns has removed almost all of the remaining desire.

Mounted conveniently on the roof of the pilot houses of the New York police tugs are rapid-firing rifles which can be swept entirely around the compass. These guns will literally squirt bullets of the regulation army size at any desired target within a range of twenty-eight hundred yards, or considerably farther than a mile, with accuracy. They are not aimed. When the searchlight of the launch discovers a pirate craft, the gun is pointed in its general direction—and the trigger is pulled. The business of hitting the target is just as easy as squirting water from a hose on a man who is passing your front yard.

The crews of the eleven New York police boats were given daily practice all last summer in the Ambrose Channel off Staten Island.

Each launch carries five hundred rounds of ammunition. When pirates are pursued, one of the three men who comprise the crew, is stationed at the gun, another steers the boat and directs the searchlight, while the third takes care of the engine

When the character of the enemy is believed to be more dangerous than usual, the patrol boat which is equipped with a Hotchkiss one-pounder, projecting a shell about two inches in diameter, is called into service. It will throw a projectile accurately more than two miles.

Our Helpless Coast Defenses

IN one hundred years of naval warfare the range of guns has increased twelve times, the weight of broadsides twenty times, the speed of firing twenty times and the weight of projectiles eighty times. The most powerful weapons at present mounted on a battleship are the fifteen-inch guns of the *Queen Elizabeth*, England's famous superdreadnought. They can hurl sixteen-hundred-pound shells from one end of Manhattan Island to the other—a distance of fifteen miles

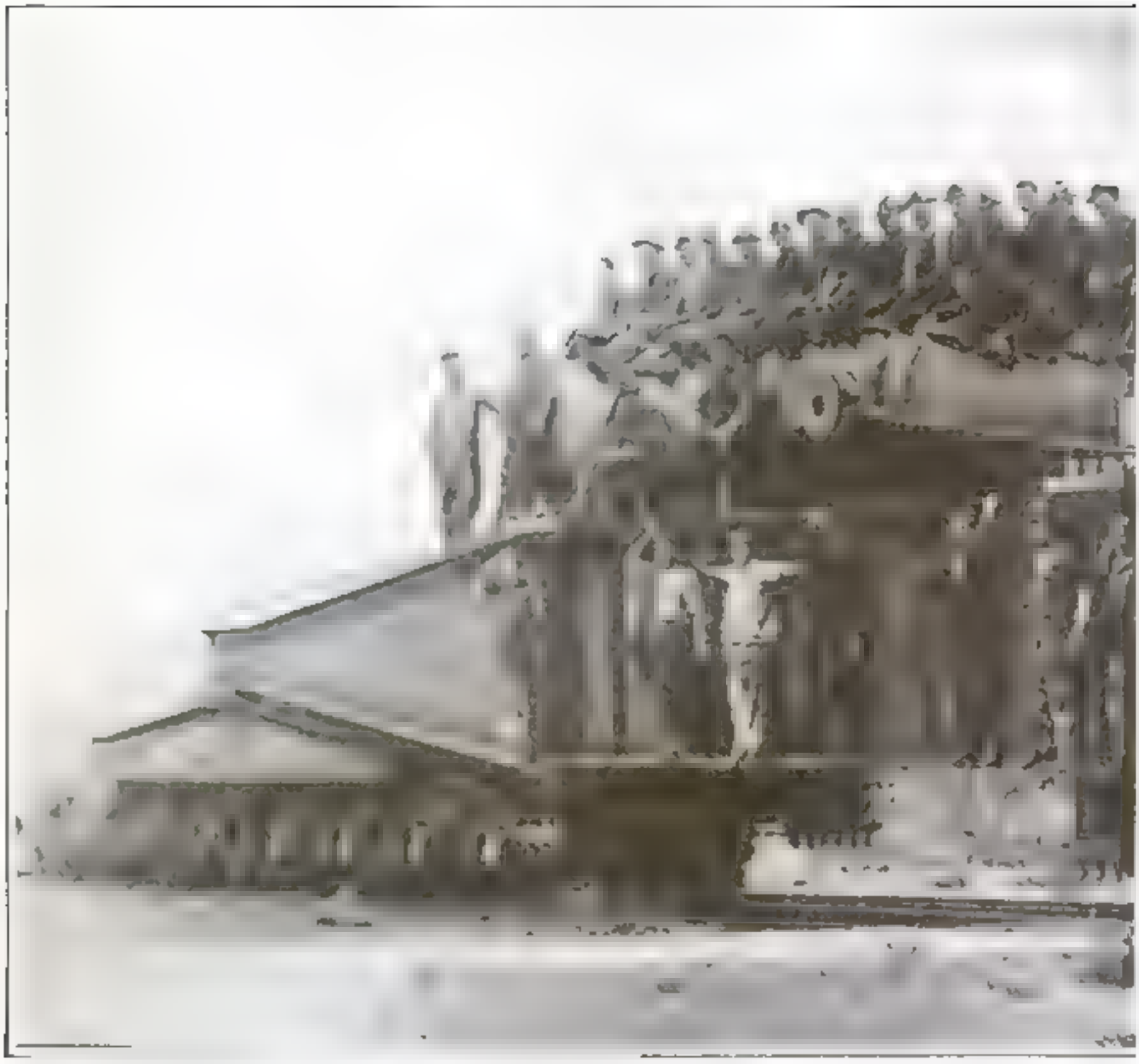
The *Queen Elizabeth* could stand off nearly two miles beyond the range of our largest twelve-inch coast defense rifles at Sandy Hook and destroy the fort. And we—we could do nothing. The splashes from our shells would be seen by the officers on shore—evidences of our inferiority.

© American Press Association

The gun crew of a twelve-inch mortar in one of our coast-guard forts. These squat guns fire a heavy projectile high in the air, and are able to do great damage during an engagement. The shell at long ranges rises three or even five miles in the air and drops almost perpendicularly on its target

Making a Fourteen-inch Gun Hit Harder

The performance of the fifteen-inch guns mounted on the latest English superdreadnoughts have stirred the ingenuity of our naval ordnance experts. For our new battleships, the *California*, *Mississippi* and *Idaho*, fourteen-inch guns of forty-five-caliber were specified. The caliber of a gun is simply its muzzle diameter divided into the length; a six-inch gun of fifty caliber is twenty-five feet long. Obviously these fourteen-inch guns would be at a disadvantage if opposed by the fifteen-inch guns of a *Queen Elizabeth*. Accordingly, their length has been increased to fifty calibers. Because the gun is longer, the powder is able to give the shot an additional push, as it were. Rear-Admiral Joseph Strauss, Chief of Ordnance of the United States Navy, gives it as his opinion that "these guns, although of less caliber and weight than fifteen-inch guns now mounted abroad, are capable of penetrating the heaviest side armor at oblique impacts and at the greatest effective battle range, and give us the advantage of flatter trajectory with greater volume of fire due to



We have built exactly two sixteen inch coast defense guns, one of which is shown in

Fourteen inch guns of this size are installed on the super-dreadnoughts New York, Texas, Oklahoma, Nevada, Pennsylvania and Arizona. The fifteen inch guns of the Queen Elizabeth can out range these weapons. For the newest of our battleships this fourteen inch gun

the picture. These guns are intended to be used at the two ends of the Panama Canal

will be lengthened so that the powder charges may exert a longer push on the projectile. It is claimed that this expedient will make our fourteen-inch gun of the future even more powerful than the fifteen-inch gun of the Queen Elizabeth, which at present is unequaled

the increased number that we are permitted to mount on any ship of equal displacement."

But we have not rested here. In August, 1914, a type of sixteen-inch gun forty-five calibers in length was tested. This gun fulfilled the expectations of its designer. It is probably the most powerful gun in existence to-day. Some day it will be mounted on our battleships.

A Modern Fourteen-inch Gun Is Better Than Sixty Thousand Muskets

The projectile of the modern fourteen-inch naval gun starts at a velocity of about two thousand six hundred feet per second. Its weight is one thousand four hundred pounds. Compare this with the weight of a musket-bullet —one hundred and fifty grains—which starts with a velocity of two thousand seven hundred feet per second. Rear-Admiral Bradley A. Fiske has made a very interesting comparison of the striking energy of the two. "After the bullet has gone, say five thousand yards, its energy has fallen to zero, while the energy of the fourteen-inch projectile is nearly the same as when it started. While it would be truthful, therefore, to say that the energy of the fourteen-inch gun within five thousand yards is greater than that of sixty thousand muskets, it would also be truthful to say that outside of the five thousand yards millions of muskets would not be equal to one fourteen-inch gun."

The high-powered, long range fifteen-inch guns mounted on modern dreadnoughts of the *Queen Elizabeth* type have made it necessary for the United States of America to consider its coast defenses. Remember that the *Queen Elizabeth* can fire her great guns accurately at a range of twenty-five thousand yards, and that our best coast defense guns could not touch her, partly because they are mounted on obsolete disappearing carriages which do not permit an elevation of more than fifteen degrees, and partly because the guns on dreadnoughts of the *Queen Elizabeth* type represent the very latest advance in ordnance. Even our newest fourteen-inch coast-defense guns, of which five were completed last year, have a maximum range of only eighteen thousand yards, which has been increased to nineteen thousand three hundred by enlarging the powder chambers.

Some idea of the power of a modern fourteen-inch coast defense gun may be gained when it is stated that its sixteen hundred pound projectile gun will drill through nearly twenty-three inches of the best quality of armor at one thousand yards and through ten inches at one thousand nine hundred yards. The fourteen-inch coast defense gun made at Watervliet Arsenal, weighs when finished one hundred thirty-eight thousand pounds, costs fifty-five thousand dollars and is wound about with thirty-seven thousand pounds of wire.

Realizing that even this mighty weapon is too feeble an opponent for a *Queen Elizabeth*, we are beginning to build sixteen-inch coast defense guns. They are the largest and longest in the world. Unfortunately only two of them have been built, and these are intended for Panama, to protect the canal.

Shots That Cost One Thousand Dollars Each

At an elevation of forty-three degrees, such a gun will have a range of twenty-one miles. That is about the distance which many suburbanites have to travel in an hour in order to reach their offices in New York city. The piece alone weighs one hundred twenty-seven tons. The shell, two thousand four hundred pounds, can pierce twenty-one inches of armor 2.8 miles. The powder charge is four hundred pounds. The shell and powder alone cost one thousand dollars.

The most commendable feature of our fortifications are our mortars. They are first-class and their high angle fire is as good as there is anywhere. Our twelve-inch mortar fires a shell weighing one thousand and sixty-four pounds and has a maximum range of twenty thousand yards.

Our coast defenses are in reality harbor defenses. Of our five thousand miles of coast line not more than three hundred are under potential protection of fortifications. The greater part of our seaboards is absolutely undefended at the present time.

Ladder Tipped With Mule's Feet

This ladder has feet like a mule, and that is why it can be safely tilted in any position. Four cupped pieces of rubber, secured by means of stout pins, swing on the ends of the ladder. They have just enough play to fit any inequalities of the ground or surface against which the ladder is placed

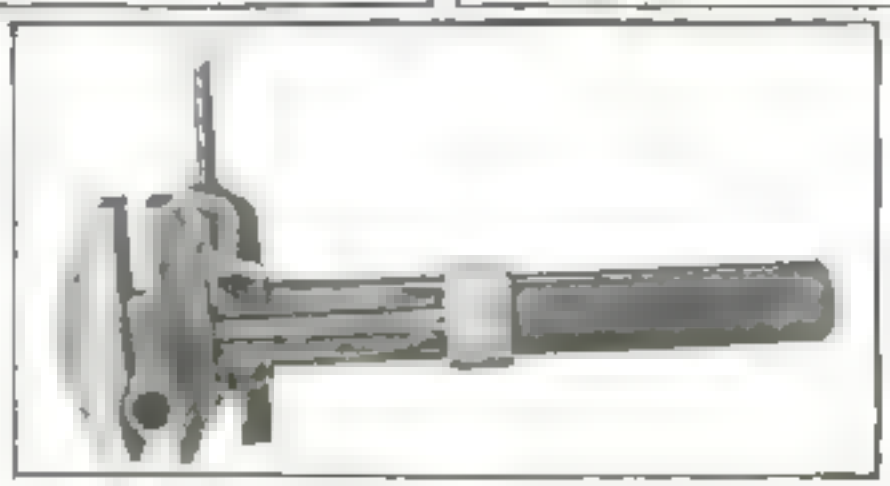
NOT every ladder will stand with perfect safety at almost any angle on rough and uneven ground or on a polished surface. The one shown in the illustrations will, because of the tips which are placed on either end.

The mule is among the most sure-footed of animals. From his feet the inventor has taken his cue and made a ladder-tip like a mule's foot. The tip is metal and rubber, the rubber grips the surface on which the ladder rests.

A New Quick-Acting Wrench

A QUICK-ACTING wrench invented by Fred G. Rockwood, Mendota, Wis., has a movable jaw which may be released with the screw-threads of the jaw-actuating shaft and quickly slid into engagement with the nut to be loosened. The actuating-shaft then engages with the threads of the movable jaw and tightens it with no loss of time.

The center bar is screw threaded on two sides. To move the slidable jaw quickly, the screw-threads of the center bar are shifted so that they do not engage the slidable jaw. To lock the jaw, the operator gives the collar a turn.



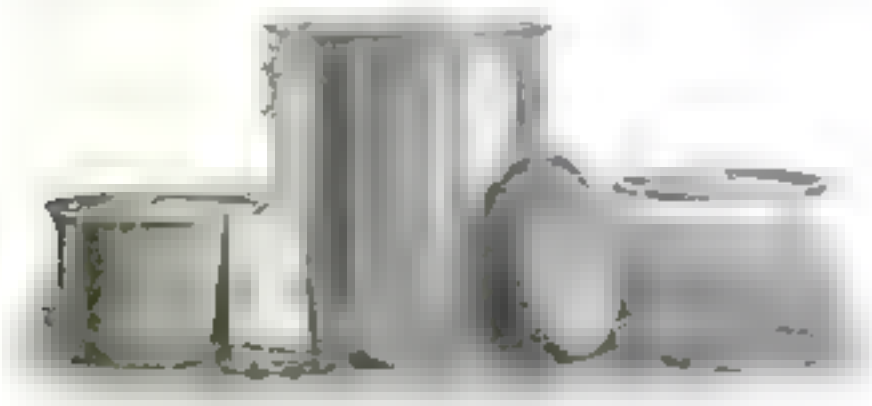
Upper pictures show movable jaw, loose, and being locked. Lower picture shows the wrench used on piping

A rope drawn by horses lifts the load to the desired height Then a clutch is released, the platform tilts, and the straw slides off

A Combined Electric Stove and Fireless Cooker

EVERYONE in this electric age knows the value of an electric stove in the kitchen, but unfortunately not everyone can afford to have one. For this reason the new electric fireless cooker will largely fill this want. Not only is the original cost less than that of the stove, but the cost of operation also is decidedly reasonable, considering that the current is on but a few minutes while the food is being brought to a certain temperature.

The electric fireless cook stove departs from the usual fireless cooker in that it has no soapstone radiators to clean, heat, or handle in any way. One permanent, stationary radiator is concealed in the bottom, and in this heat is stored and radiated. The kettle and pans are placed on the heavy wire rack, and the current turned on for a short time. A steam-escape valve warns of the danger of explosions. Though this stove has many advantages over the earlier types, the price is within the range of the average pocketbook. Many housewives will welcome its use, especially on hot summer days.



An electric fireless cooker which has no soapstone radiators to be cleaned, heated or handled in any way

Straw-Stacker Does Away With Man and Pitchfork

A MACHINE that does away with the laborious process of stacking straw with pitchforks has been put into use on some of the farms in Kansas.

The apparatus performs its task as an elevator, raising the straw from the ground and depositing it on the top of the stack. The elevator works on pulleys attached to a stiff frame on wheels.

A rope drawn by horses lifts the weight to the desired height, when a catch is released by the operator and the platform tilts and the straw slides off. By way of contrast, the old type of stacker is shown to the right in the accompanying illustration.

The Gila River is too deep to be forded. Hence this trolley ferry was constructed

Operating a Stage under Difficulties

OPERATING a stage line is not all that it's cracked up to be when the line happens to be in certain parts of New Mexico. The illustration shows one of the difficulties—and the picture was taken under very favorable circumstances.

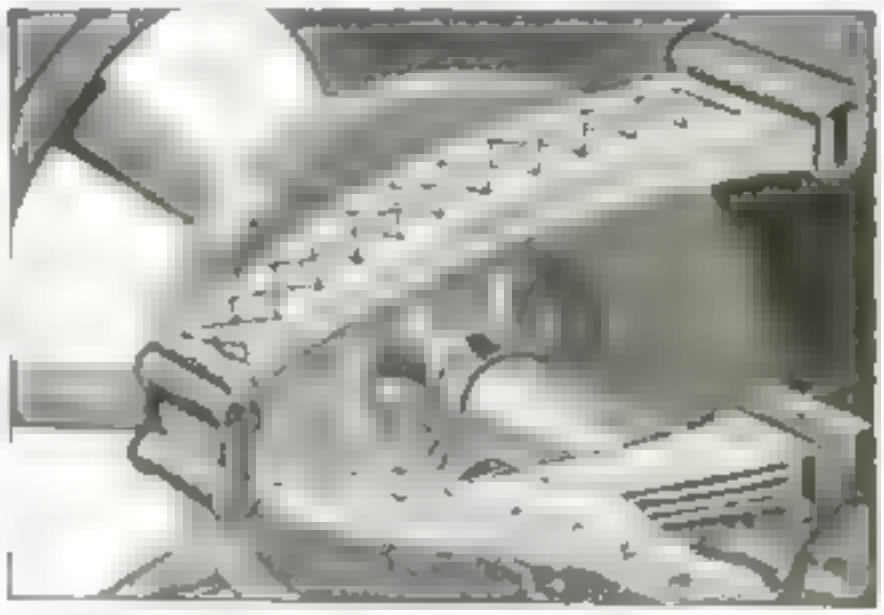
The route of the stage is between Silver City and Mogollon. As the Gila River generally is too deep to be forded, it was necessary to construct the "bridge" shown. The car is run on to the platform at one side and then pulled to the other side by a team of horses. Last winter the "bridge" washed out and the automobile was dragged across on the bottom of the stream with nothing showing but the top of the steering wheel. It took ten horses to do the trick.

A Calking Compound

A GOOD calking compound can be made by melting separately 1 lb. of beeswax and 2 oz. of rosin. When melted, mix them together. This amount is sufficient to calk a 16′ boat. The compound must be applied while hot, and can be poured into the seams or applied with a varnish brush, and the surplus scraped off with a putty knife. The hot compound will penetrate the wood, thus obtaining perfect water-tight seams. If the seams are very large, first calk tightly with cotton.

Gaiters to Protect the Spring-leaves of Automobiles

THE importance of keeping the spring-leaves on automobiles clean and thoroughly greased, cannot be overemphasized. Every motorist soon feels the effects of poor spring lubrication. A novel device which reduces the trouble to a minimum, by keeping the springs free from dust and grit and from the corroding influence of rain water, which somehow or other always manages to creep between the leaves, is shown in the accompanying illustration. It consists of plain leather or canvas gaiters, two for each spring, easily attached and detached. Additional grease can be injected at any time without the trouble of removing the gaiter, by means of a tube and screw-cap attached at the side.



Gaiters for automobile leaf springs keep out dust and grit

By means of this new attachment, a shaper is converted into a power hack-saw machine

An Improved Hack-Saw Attachment

A NEW hack-saw attachment has recently been perfected which instantly converts a shaper into a power hack-saw machine. There are many advantages to be found in this improved arrangement, one of them being the saving of floor space and of the additional shafting space and extra pulleys that would otherwise be required.

The instant raising or lowering of the cutting edge of the hack-saw blade by elevating or depressing the tool-head of the ram, enables the operator to slit tool-steel, or any piece of work that will go in a shaper-vise, end up or lengthwise as desired. Since shaper-vises can be swiveled to any desired angle instantly, angle cuts at any degree can be made without loss of time, and the vise capacity is thus greatly increased.

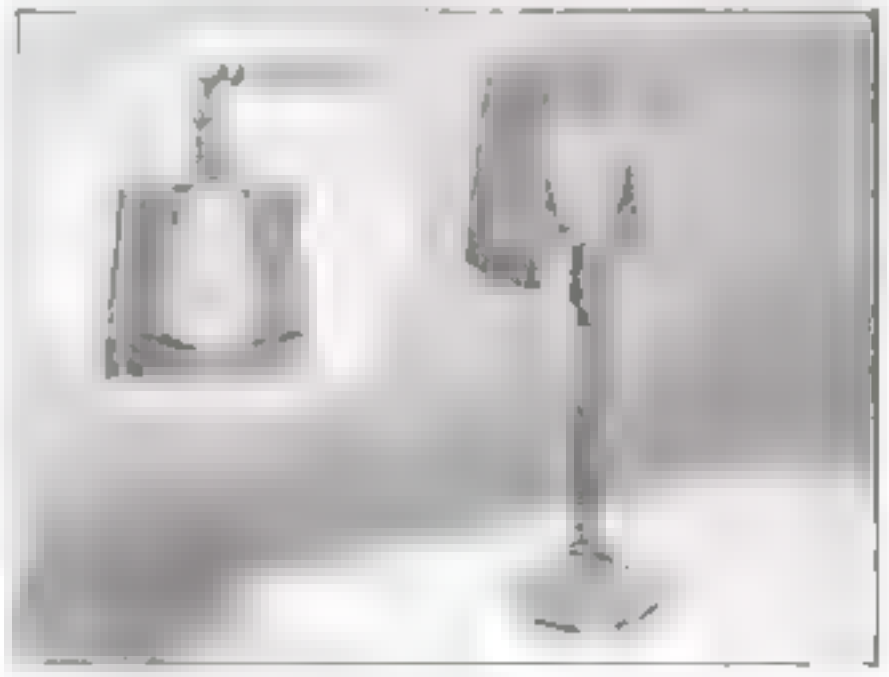
The vise-bed can be raised or lowered at will, or it can be shifted from side to side. The wide range of adjustment of the shaper-bed renders it possible to make cuts on large pieces of work which would otherwise require mounting on a milling-machine. Cuts can also be made at the same setting in dimensional relation to each other.

Perhaps the most important advantage of all is the privilege of changing the length of stroke of the blade. This can be operated by the ram-gage on the back of the shaper to drive the saw, from one-eighth of an inch up to and including the full length of the blade, whether it be twelve, fourteen or seventeen inches.

The connecting arm is simple in construction. It has a covered protector at its base which prevents the dropping of the frame itself at the completion of the cut. The lack of this feature in most hack-saw machines is of the greatest disadvantage, since the dropping of the frame causes the breaking of more blades than any other one thing.

This Lamp Shade Will Not Scorch

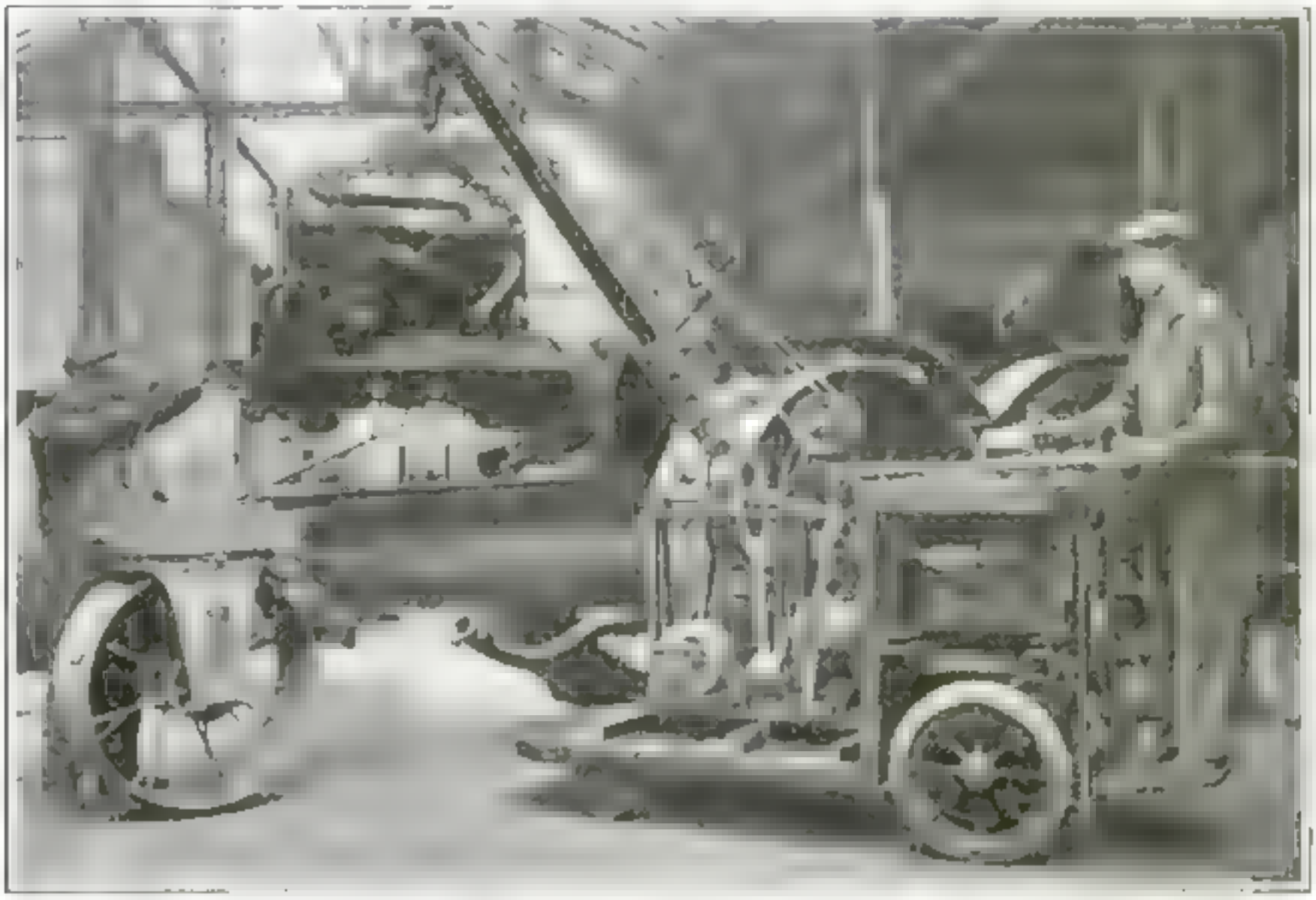
A DECORATIVE silk lamp-shade which can be slipped in place over electric-light bulbs of ordinary sizes has been put on the market by an electrical manufacturer, who claims that, unlike most shades of this sort, the silk will not be scorched. The silk is fastened about a light wire frame, which is slipped easily on to an incandescent bulb and held in place by spring clips. A disk of mica is put at the base of the bulb, so that in case the socket has not been properly grounded, anyone touching the wire frame can not receive a shock, because of the insulative qualities of the mica.



The electric bulb will not scorch the silk

Midget Crane Has Giant Ability

A TINY crane, so apparently helpless that it is difficult to imagine its doing actual work about a large factory, is in use on the assembling floor of a tractor plant in Cleveland. The crane, despite its appearance, has tremendous capacity. It can seize and lift a weighty automobile or tractor engine from the floor, swing it up into the air and into the chassis without so much as a grunt or a groan of protest.



The midget crane runs around the factory under its own power, on a body which looks like an electric baggage truck. It can lift weights apparently far out of proportion to its size, and it is controlled by one man

The crane with its operating mechanism is mounted on a rigid, four-wheeled truck. It travels about and performs its required lifting all under the guidance of one man.

Making a Hen Lay Self-Preserving Eggs

THE POPULAR SCIENCE MONTHLY for January gives an account of a Chinese method of preserving eggs by coating them in hard clay. It is an interesting process, but more or less laborious.

Four years ago, Dr. Oscar Riddle, now of the Carnegie Institution, undertook in a leisure moment to see if he could not make a hen lay an egg which should be self-preserving. He succeeded very well.

By his method the hen was fed urotropin, administered in capsules at the rate of less than a gram a day. Urotropin is deposited in the egg, where it changes into formalin, a well-known preservative

Eggs laid within twenty-four hours after the first dosing, as well as those laid five days after, were sufficiently affected to be preserved. Dr. Riddle tested the keeping power of the eggs in comparison with those from untreated hens under particularly severe circumstances. Eggs of both varieties laid in the month of July were allowed to stand in a temperature varying from seventy-eight degrees above zero to twenty-five below. By the middle of September the difference between the two kinds of eggs could be easily detected; by the middle of November all the eggs from undosed hens were spoilt while those from urotropin-fed hens were still edible, although they had lost some of their bulk of water.

The drug does not injure the hens, and is obtainable at small cost.

The old Dutch wooden shoe as an advertising device on wheels

A Quaint Advertising Automobile

DESIGNED to resemble a wooden shoe, such as the peasants of Holland wear, the automobile pictured is curious enough. The lines of the sabot are correctly followed, and even the appearance of wood is secured by artistic graining. It is a most attention-compelling bit of advertising on wheels.

Gravity-Flow Gasoline Supply Station

THE owner of an automobile gasoline supply station installed a tank with a glass gage. The tank is much above the fuel tank of any automobile, so that the gasoline flows by gravity, the quantity being controlled by the purchaser at his machine. The tank has been accurately calibrated and checked by an official. This insures no shortage from leaky valves. This apparatus is less expensive and easier to operate than an ordinary pump.

Why not let gasoline run down into your fuel-tank instead of pumping it up by armpower?

A Portable Wrecking-Truck

A SMALL light-weight wrecking-truck, which can be carried with ease in a relief car, has been designed by a Danville (Ill.) man, and has been useful in his business. When called from his garage to tow in a wrecked car with a smashed wheel, he does not have to drag in the wreck on a four-by-four timber, set under the axle of the missing wheel, but slips the truck in place instead and tows the car home without difficulty. It fits under the front or rear axles with a few minutes' work, and the caster-like arrangement of the wheels makes it easy to steer.

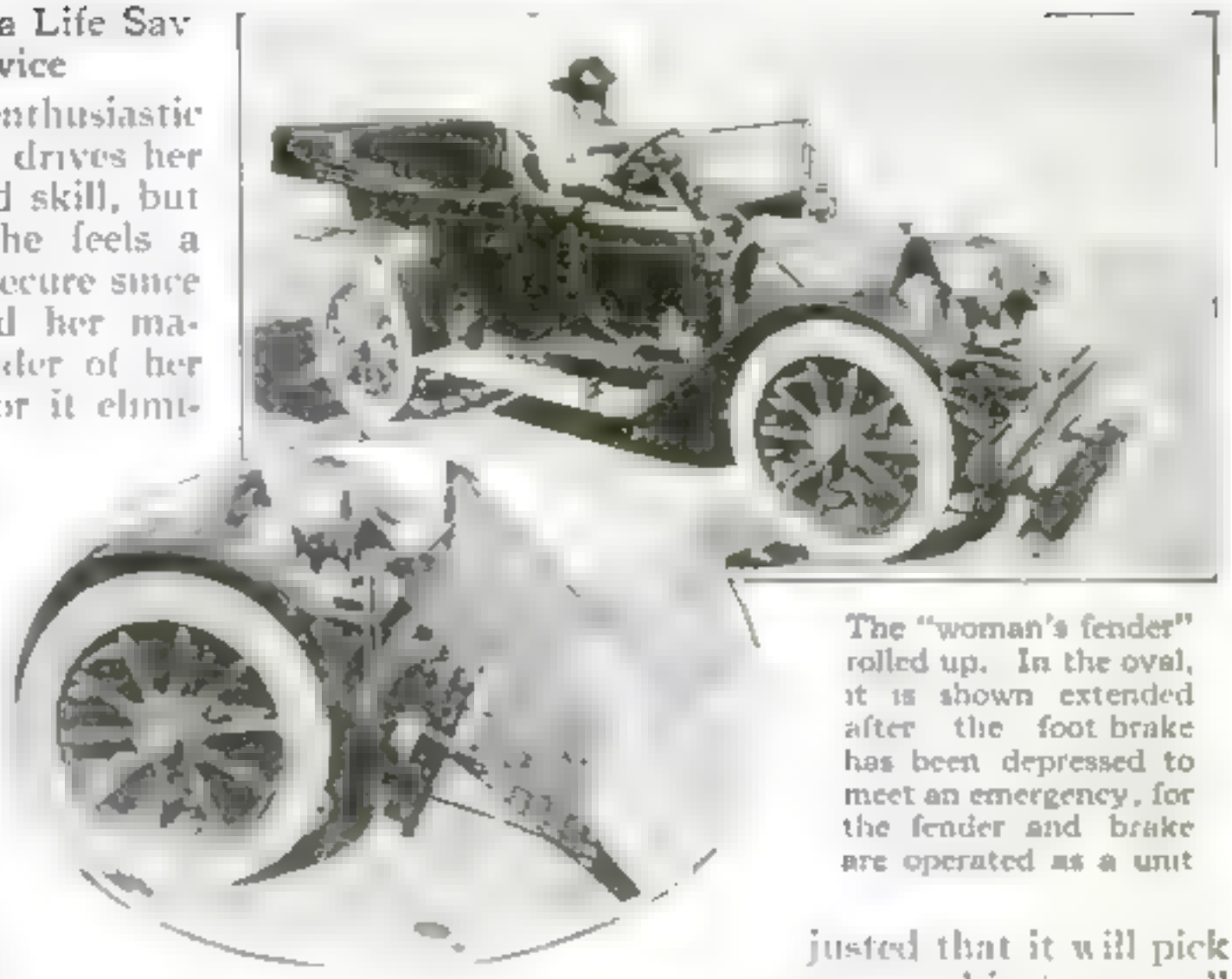
Is it not better to tow a wrecked automobile in this way than with the usual awkward timber drag?

An Oil-Proof Cement

A CEMENT which will not be affected by oil is made by mixing glycerine and litharge to the consistency of a thick paste. This will be found very handy in repairing cracked oil-reservoirs or in making an oil-tight joint between two metal plates. The cement should be applied as soon as it is mixed, since it hardens very quickly.

Woman Invents a Life Saving Device

SHE is an enthusiastic motorist and drives her car with ease and skill, but just the same she feels a great deal more secure since she has equipped her machine with a fender of her own invention, for it eliminates the danger of injuring some unwary pedestrian. Who is she? Mrs. J. M. Wirt of Omaha. Her fender is enclosed in a small case extending across the front wheels. When not in use it is inconspicuous and does not disfigure the car. In an emergency it springs open like a flash, throwing out a net four feet in front of the wheels. The net is so accurately adjusted that it will pick up an object as small as a brick; yet it is strong enough to carry a weight of two hundred and fifty pounds.



The "woman's fender" rolled up. In the oval, it is shown extended after the foot brake has been depressed to meet an emergency, for the fender and brake are operated as a unit

The releasing-trip operates the brake and fender simultaneously.

Riveting Without Rivets

ELECTRIC current, reduced to an extremely low voltage but increased in volume to tremendous proportions by the use of huge transformers, finds an unusual and spectacular application in performing the work that rivets are intended to perform. The chief distinction between the ordinary rivet and the electric rivet is the difference in time that is required in the two operations The results are equally successful. Electric riveting requires much less time. Riveting, however, is not the precise word, as welding is the operation that actually takes place. Two layers of metal to be joined are placed together between the jaws of a giant machine. A lever is pulled; electric sparks fly; a spot between the jaws quickly heats to brightness; the two surfaces melt and flow together. The result is a permanent but practically unnoticeable weld.

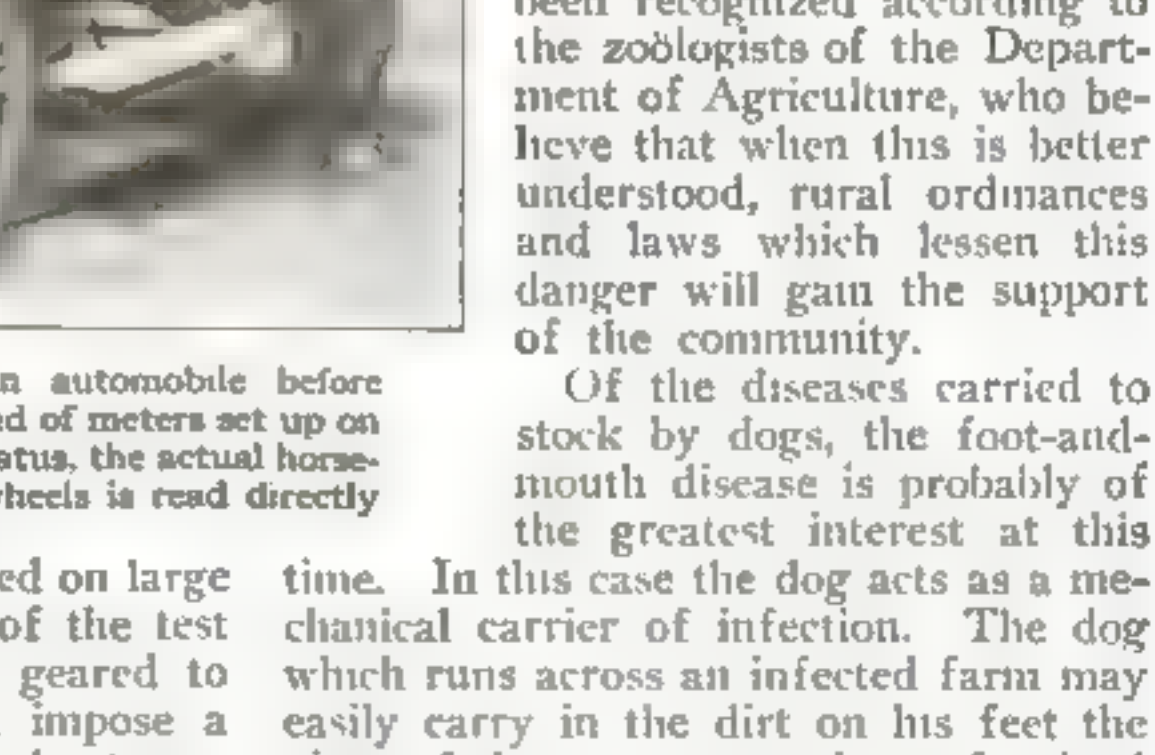
Intense electric heat, applied in one spot after another, welds the steel more firmly and more quickly than is possible with the use of rivets

Motor-Testing Up To Date

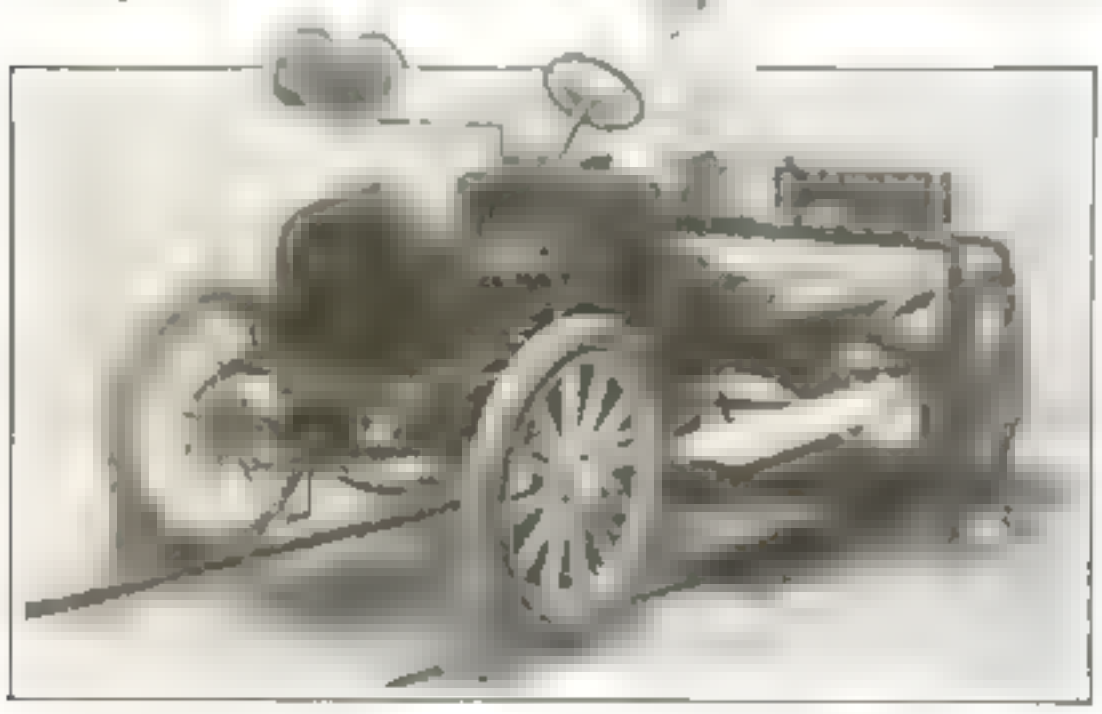
THE accompanying illustrations show two methods which are used in two motor-car factories for testing every chassis before it is turned over to the sales department for ultimate sale to the consumer

In one method of scientific testing the semi-finished chassis with the motor in place is fastened beneath great air-fans. The rear wheels are belted to the fans which act as a brake. The motor is tested in this way. The power it develops is used to test the remainder of the chassis. Three frames at a time are tested. Following this test, tires are put on the cars and they are given a road trial.

In another method of testing, the rear wheels of the completed chassis are placed on large rollers set beneath the floor of the test house, and these rollers are geared to electric dynamometers which impose a load on both the motor and the transmission elements. With the aid of meters, set up on a standard in front of the operator, readings of the actual horsepower delivered to the rear wheels can be taken directly. Incidentally, it is interesting to note that the power developed is not wasted but is used to light the test house



The testing plant of a modern automobile factory



Testing the horsepower of an automobile before leaving the shop. With the aid of meters set up on a support in front of the apparatus, the actual horsepower delivered to the rear wheels is read directly

The Dog as a Carrier of Disease

THE dog in the country is a useful and pleasant adjunct to the farm if he is properly controlled and cared for, but when neglected, may readily become a carrier of disease to stock, in addition to gaining opportunity to kill sheep and destroy gardens and other property. Dog ordinances, as a general rule, have been intended chiefly to curb the dog's power of doing harm by attacking, biting, killing or running sheep or stock. The part that he plays as a carrier of diseases to animals only recently has been recognized according to the zoölogists of the Department of Agriculture, who believe that when this is better understood, rural ordinances and laws which lessen this danger will gain the support of the community.

Of the diseases carried to stock by dogs, the foot-and-mouth disease is probably of the greatest interest at this time. In this case the dog acts as a mechanical carrier of infection. The dog which runs across an infected farm may easily carry in the dirt on his feet the virus of this most contagious of animal diseases to other farms, and thus spread the disease to the neighboring herds.

There are, however, many other maladies in the spread of which the dog takes an active part. Rabies, hydatid, ringworm, favus, double-pored tapeworm, roundworm, and tongueworm are often conveyed to human beings in this

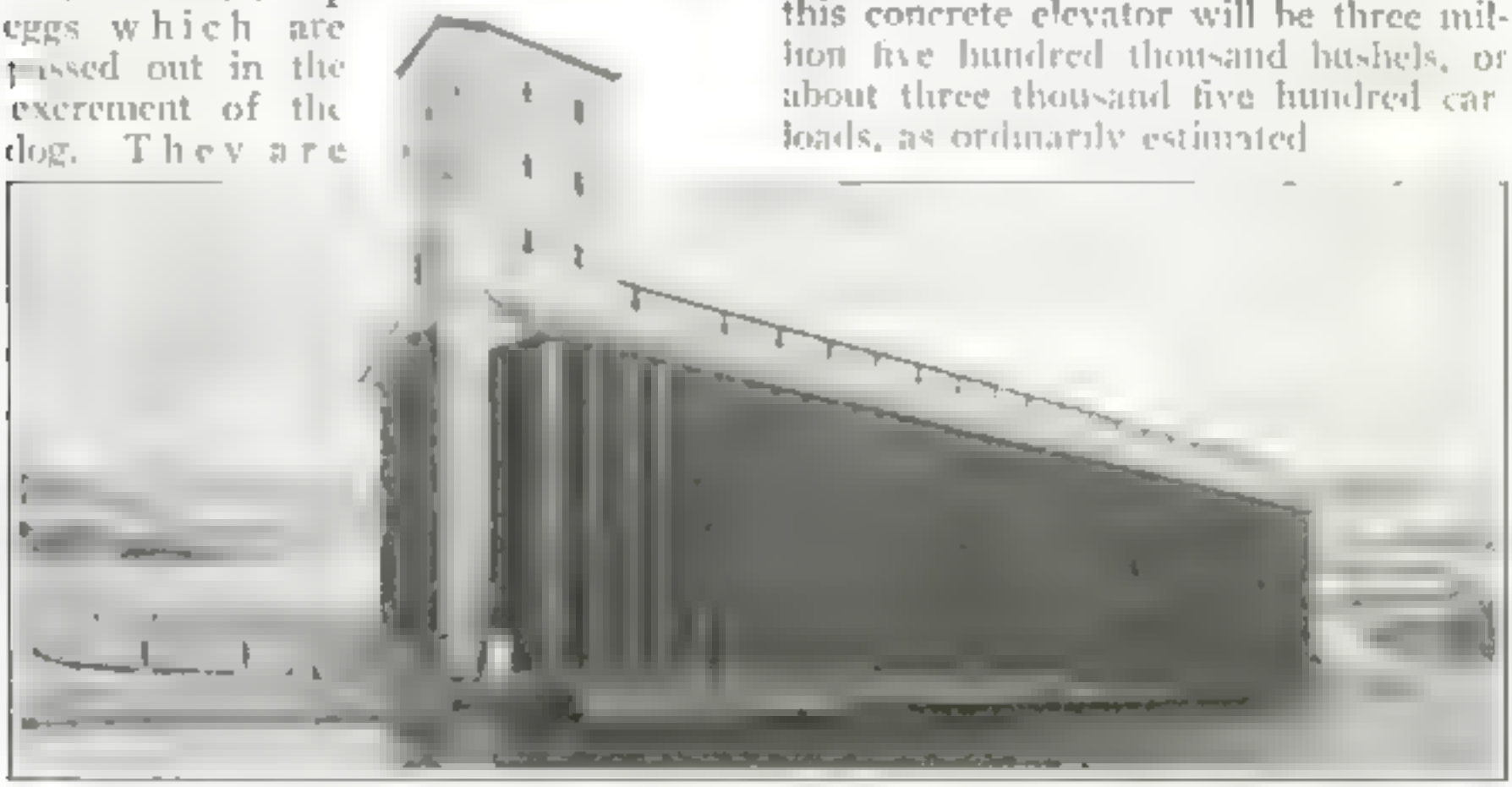
way. Occasionally the dog helps fleas and ticks in transmitting bubonic plague or the deadly spotted fever.

Hydatid disease is caused by the presence in the liver, kidneys, brain, lungs, and other organs, of a bladder worm or larval tapeworm. Bladder worms are often as large as an orange and may be larger. A dog which is allowed to feed on carrion may eat all or part of a bladder worm containing numerous tapeworm heads. These tapeworm heads develop into small segmented tapeworms in the intestines of the dog. The tapeworms in turn develop eggs which are passed out in the excrement of the dog. They are spread broadcast on grass and in drinking water where animals can very well eat them and thus become infected. The hog is particularly liable to this disease because of its rooting habits. The eggs may get into human food, and persons who allow dogs to lick their hands and face also run the risk of getting the eggs of the tapeworms in their systems.

The parasite which causes gid in sheep somewhat resembles the hydatid worm. A dog allowed to eat the brain of a giddy sheep may swallow this parasite and later distribute the eggs of the resulting tapeworm over the pasture. Sheep while grazing swallow the eggs with the grass which they eat. In the case of sheep dogs it is important to administer vermifuges often enough to keep them free of these worms. In the case of sheep measles, the bladder worm in the meat, typical of this disease, is swallowed by the dog and again the tapeworm eggs are passed by the dog to grass or water, and there are eaten by sheep.

A Grain Elevator Which Holds Three Thousand Five Hundred Carloads

ONE of the greatest of all elevators, is the concrete grain elevator which has just been completed in Fort Williams, Ont. The storage capacity of this concrete elevator will be three million five hundred thousand bushels, or about three thousand five hundred carloads, as ordinarily estimated



Thirty five hundred carloads, or nearly one hundred long trains, must carry the grain this elevator can hold at one time. It can load fifty thousand bushels in an hour and can empty itself, if the cars are available, in ten hours

The outstanding features of the concrete elevator are its marine unloading cars, which can empty any of the largest boats in less than ten hours. The marine unloading cars have a capacity of about fifty thousand bushels an hour and are capable of unloading a big boat in less than a working day.

It will be possible to load fifty thousand bushels of grain in freight cars every hour, which is tremendously fast Canal boats can be loaded at the fast rate of thirty thousand bushels an hour. Aside from the great size and wonderful appliances for handling grain which have been incorporated in this elevator, the fact that it is constructed entirely of concrete reduces the liability of fire and with it the cost of insurance.

Decoy Targets for Zeppelins

By R. J. Bjierstedt

THERE is no doubt that more powerful guns are now available than those which made so ridiculous a showing during the September and October raids on London, but the problem of adequate range finding is so nearly prohibitive that few who are familiar with it pin much hope to a gun defense.

I am credibly informed, however, that what might be called "diversionary" protective measures have been employed with considerable success. These consist of various ingenious devices calculated to draw the fire of the Zeppelins away from the points where they could do the most harm. So far, these appear to have been employed principally in the important manufacturing districts between London and the North Sea rather than in the immediate environs of the metropolis. The idea is said to have originated in the mind of a Norfolk farmer after a pile of chaff which he had been burning on the night of a raid was made the target of several well-placed Zeppelin bombs.

"The Zepps thought my fire was the blast of the —— mills," he told an air service officer. "Why not have some ready to fool 'em the next time they come?"

Since factories and barracks were the main objects of attack, why not provide some that could be found without difficulty and the destruction of which would be of small moment. The first experiment was made by cutting "window-holes" in a row of bill-boards—"hoardings" the English call them—along a railway, and illuminating each orifice with a carbide lamp. When these came in for attention from the raiders, the present plan of using "stage scenery" factories and barracks as Zeppelin decoys was outlined.

These decoys consist simply of sections of imitation walls, pierced with windows, which, by means of guys and props, can be made to represent the side or sky-lighted roofs of a factory or barracks. Where practicable the illumination is furnished by running a cable from the nearest electric transmission line, and where this is too troublesome or expensive, carbide or kerosene lamps are employed. The sections hook or clamp together and are made small enough to allow of a stack of them being carried on one of the big war motor trucks.

An interesting light is thrown on this phase of protective work by a photograph that was published in England about three months ago, and probably also in the United States. It showed a huge war motor truck, with an enormous tarpaulin-covered load, stalled between the copings of an old stone bridge over which it had endeavored to pass. The caption merely explained that it was "Somewhere in England," and that the load itself was an "official secret." Most of the information which I have set down above came to me as a consequence of this photograph.

I chanced to be looking over the copy of the *Daily Mirror* on the cover of which the view in question appeared, when a garrulous and slightly inebriated "Tommy" who shared my third class apartment with me asked if I knew what the load was.

"Not beyond the fact that it is an 'official secret,' I replied. "Do you know anything about it?"

"Blime me if I don't," was the answer. "She wuz carryin' stage scen'ry; stage scen'ry fer the Zepps."

The man, it appeared, was a member of the Army Service Corps, and was just returning from the hospital where to use his own words, he had been to "git a hunk o' 'fact'ry'" picked out of him.

His injuries, he said, had been received when a "factory" which he had helped to erect was actually struck and demolished by a Zeppelin bomb. They had just switched the lights on from their dug-out, he said, when the Zeppelin hove in sight and headed up to pass right over the decoy. The "factory" was blown to pieces, but a couple of hours' repair work on the morrow left the shattered sections in as good shape as ever.

Decoys for Zeppelins

In order to deceive bomb-dropping Zeppelins, the English are building "stage" factories (mere painted scenes) which are illuminated at night

What the gun pointer sees through the loop-hole of a German gun shield

The armored Italian captain of one of the numerous wire-cutting "Death Companies"

© International Film Service

The Italians now possess heavy siege guns which compare very favorably with the German and Austrian guns which did such great execution at Liege and Namur at

Courtesy Illustrated War News

Through the barrel of the gun may be seen Italian soldiers who are hauling this heavy cannon

Ingenuity of the Great War

© American Press Association

One of the tragedies of the war. The sinking of the hospital ship "Anglia" with wounded on board, after striking a mine in the English Channel. The remarkable photograph was taken from one of the rescuing ships just as the "Anglia" plunged beneath the waves, carrying down many of the wounded and their nurses

the opening of the war. The moving of these great guns to lofty positions in the Alps is no mean feat, as may be seen in the picture, showing thirty men at work

An Italian soldier wearing a steel helmet and suit of armor. His company is made up of picked men, whose perilous duty it is to cut the enemies' barbed wire entanglements before an infantry attack

A system of mirrors makes it possible for the Austrian soldier to fire his rifle without exposing himself

Soldiers Big and Little

Above may be seen a detachment of Serbians crossing the Koloubara River. This bridge has been the scene of many hard-fought engagements, having changed hands over and over again, each time being destroyed by the losers and repaired by the victors. Only enough timbers are used to permit soldiers to cross single file

Probably the youngest soldier in the Serbian Army was recently captured by the Germans. Here he is, on the left, a six year old, clothed in odds and ends which he found on the battlefield. Nobody knew where he lived. He shared the fate of the other soldiers with whom he was captured. He is now in a prison camp, where we see a German soldier giving him a light for his cigarette—since he must smoke like a regular soldier

© Underwood and Underwood

Two Queer Phases of the War

A French Red Cross dog returning from an examination of "No Man's Land" between the trenches, and bringing the helmet of a wounded soldier to the hospital corps behind the lines. These brave little animals are seldom wounded, for they seem to be the only living things respected by both armies. When dark comes, the hospital corps will venture into the dangerous territory and endeavor to collect the wounded who still live.

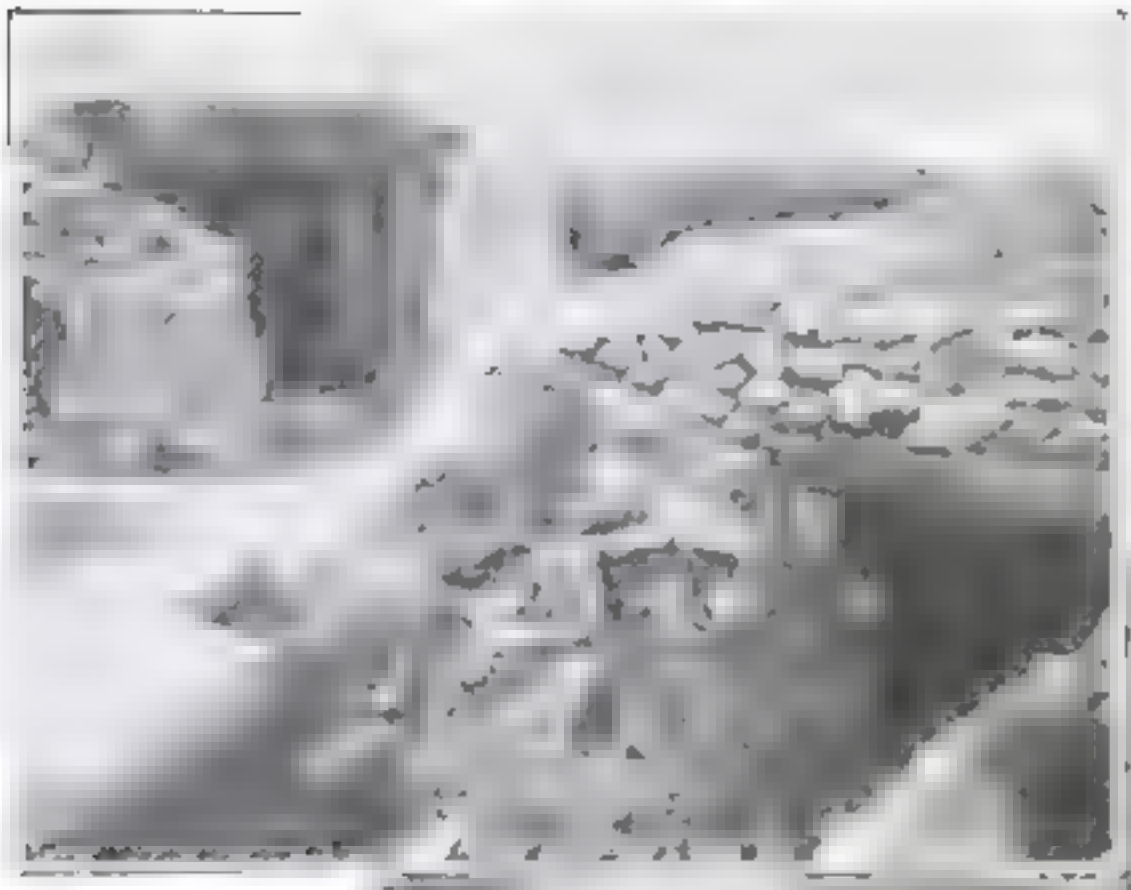
On the right, a new use for women's finery in war. Hand muffs are, so far as we know, an innovation in the trenches. Last winter the troops received a great quantity of woolen mufflers, socks and mittens, but apparently fur muffs and ear laps are in style this winter on the German battle front.

And They Call War Glorious!

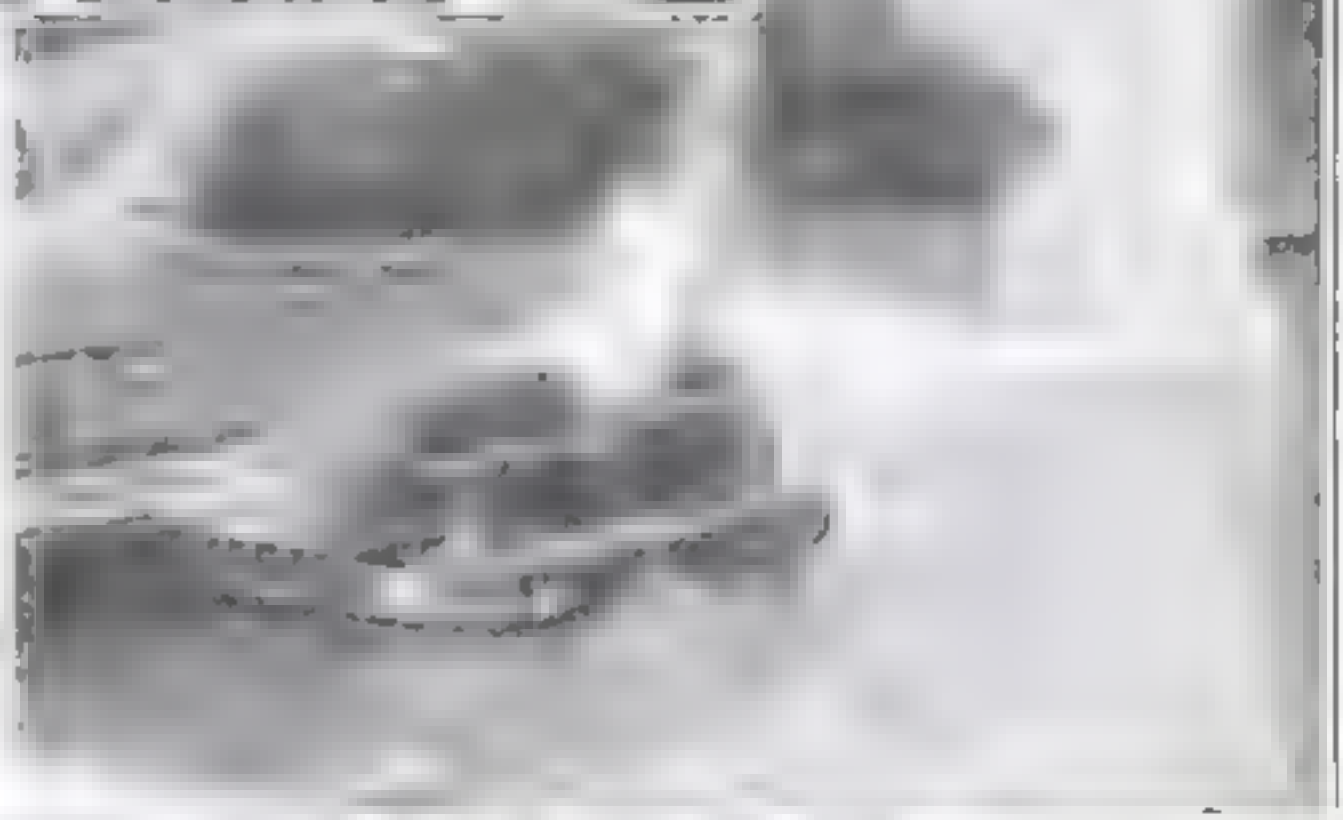
Rolling a field of mud for an aviation field. Aeroplanes must have a fairly smooth place to start from, and the ground must be hard enough to support the machine

An exhibition of war trophies was recently opened to the German public in Berlin. Great crowds have been in constant attendance, for the proceeds from the exhibition will go to the German Red Cross. In the center of the page are two of the exhibits. On the left, a searchlight which has been struck by a shell, and on the right a saddle which has been riddled with bullets and hacked by sabers. The lower picture shows the result of a rat hunt at the front The trenches are infested with rats, and now and then a rat hunt constitutes a welcome diversion from the tiresome waiting for an attack by the enemies' forces

All in the Day's Work of a Soldier



In the lower right-hand corner of the picture on the left, is shown a French tunnel which leads to a mine under the German position. The wires which will blow up the mine may be seen coming from the mouth of the tunnel



The destruction of a pontoon bridge on the Isonzo River. As is customary in modern warfare, all means of retreat and advance are destroyed whenever possible by the enemy. The illustration is a striking picture of the actual mining of a pontoon bridge which crossed the Isonzo

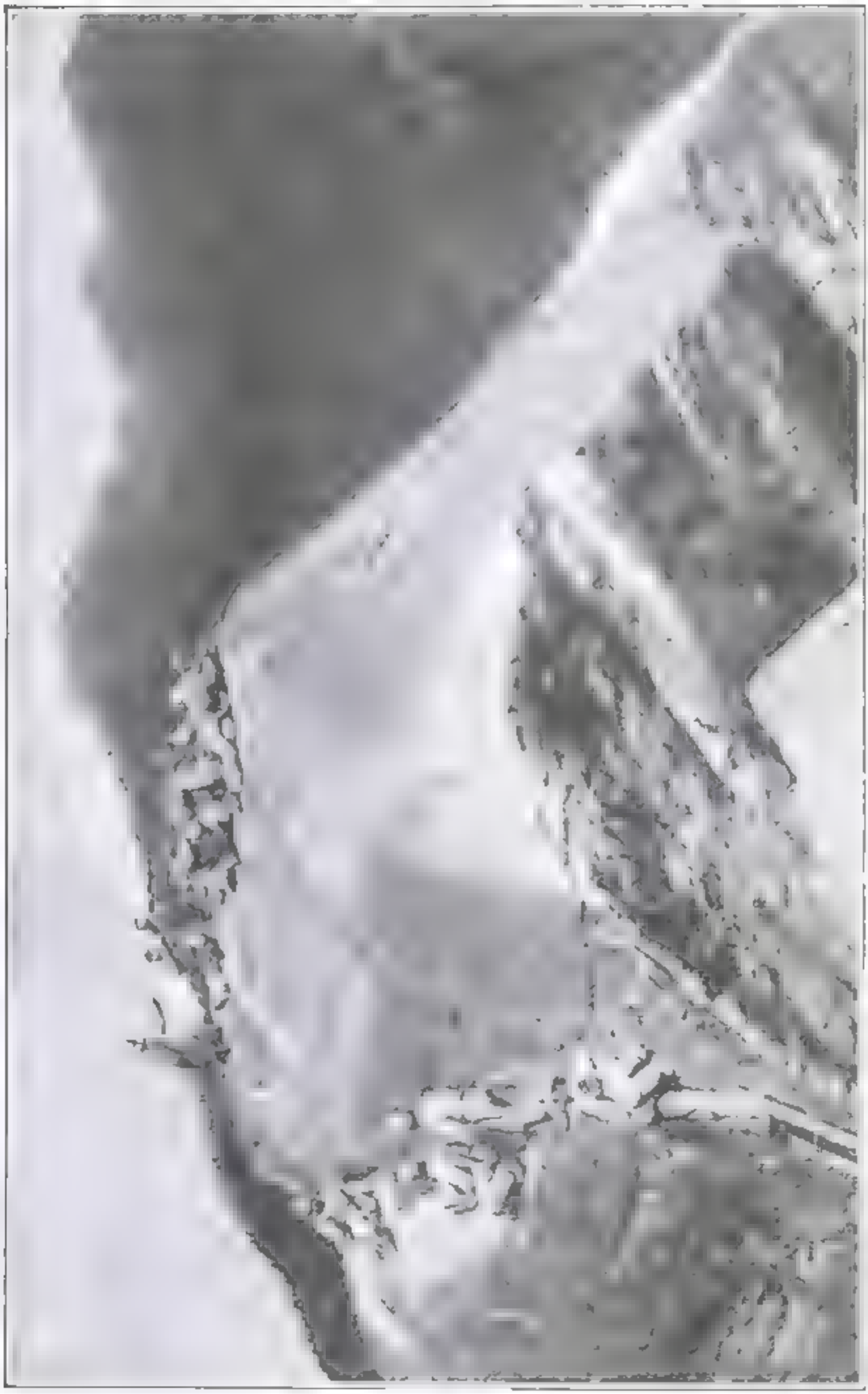
A piece of meat has been placed at the entrance to the rat's hole, and the French soldier is ready with his bayonet to strike On the right, a hospital for injured rifles near the Austro-German lines in Russia. Expert gunsmiths repair rifles and small arms which have been put out of commission by the vicissitudes of hard campaigning

Clothes of Paper and Sacking for Belgians

Samples of clothing made by the women in the devastated districts of Belgium and Northern France Empty flour sacks have been eagerly accepted by the women, and very serviceable garments for children have been made out of them By clipping off the two bottom corners of the sacks for armholes and cutting a semicircle for the neck, the sacks have been converted into the shirts shown in the pictures

Another makeshift which is proving of great value in the war. Immense quantities of paper blankets have been made and forwarded to the men in the trenches. These blankets are made of a few sheets of newspaper, which are sewed together, and sometimes covered with cloth

Natural Citadels in the Austrian Mountains



A glimpse of the Tyrolean Alps in war time. An Austrian patrol has secured, by means of ladders and alpenstocks, a position on a high rock commanding an important pass. The difficulty of dislodging even so small a number of armed men may well be imagined

In War As Well As In Peace

The fighting armies have large corps of men engaged in the trades and professions in which they were employed before the war. Shoemakers, tailors and barbers may be found in great numbers just behind the trenches. The photograph shows a German shoemaker hard at work near the front

Parisians no longer are able to make use of their favorite mode of transportation, the 'bus. Far from the busy streets of the great city, the 'busses trundle, painted an ominous war-gray, and filled with soldiers or provisions. When the battle lines move forward, the huts and shelters of the men are also brought up. The picture shows the dwelling of an Austrian commander put on skids and pushed to its new position

Necessity is the Mother of Invention

Even the copper weights on German clocks have been fired at the Allied troops! Stones have been substituted for the old copper weights

Another example of Germany's inventive genius turned to warlike purposes. The photograph shows the portable searchlight. This projector, small as it is, is remarkably powerful, and may be assembled for action in an exceedingly small space of time

He Is the Eye of His General—This Man in the Air

A German aeroplane flying above the battle front in Northern France. This remarkable photograph was taken by an officer who was flying above the aeroplane shown in another scout machine. The picture shows, with great distinctness, the squares and rectangles which indicate plowed and cultivated farm lands

There is a Question About the Gun—Not About the Ovens

© International Film Service

Does this gun, mounted on the Italian liner "Verona," as a protection against submarines, transform the peaceful passenger ship into an auxiliary cruiser? This is the new question in international law which it has raised

Austrian ovens behind the lines in the Serbian war zone. These crude ovens are made of clay, and despite their strange appearance, they are said to suit their purpose admirably

How an Enemy Trench is Mined

Courtesy of the Illustrated London News

Mining is among the oldest phases of warfare. It was developed to a high point of efficiency during the siege and trench warfare around Richmond during our Civil War, and during the present European conflict has been used successfully and continually by both sides. This detailed picture of its construction gives an accurate idea of the method followed and of the system of attack which follows the successful explosion of a mine

A Tragedy of the Skies

American Press Association

This remarkable photograph was taken from the German trenches during Lieutenant R. C. Ferrick's fall from the skies. While he was making an observation flight over the German lines in the Champagne district, his fragile machine was struck by a shell from an anti-aircraft gun and burst into flames, diving thousands of feet to the earth. The daring photographer who took this picture was forced to climb out of the trenches and stand fully exposed to the fire from the opposite trenches, but the British were watching with horrified eyes the fall of their comrade, and the photographer escaped with his wonderful picture without even being fired upon. The Germans have recently made great improvements in their anti-aircraft artillery, and as a result, Allied airmen have been forced to fly at great heights or run serious risk of being shot down

This blanket protects the man, the horse and the vegetables

A Blanket with Many Uses

WHAT is believed to be the most ingenious and practical camping blanket devised to date is the invention of J. L. Wright, of Revere, Mass. As a warm, rain-proof traveling-coat, or storm-cape, it cannot be equaled. It is long and fits snugly about the neck. Owing to its size and rectangular shape, it can be readily converted into a tent-covering. As a sleeping-bag, it is closed at the side and bottom.

The uses of this handy accessory are not confined to camping. It is a better horse-cover than an ordinary blanket, since it has all the blanket's good points, but is not so heavy on the horse's back. It does good service as a wagon-cover, fitting neatly over the sides and buckling at the corners.

Sleep in the open, warm and dry

No chance for rain to enter

Two blankets make a shelter tent

Why Legs Are Called "Cork"

THE first artificial leg, other than the ordinary wooden pegs, is said to have been made in London by a man named Cork in the early part of the nineteenth century. Hence the name "Cork leg," no matter what the material.

Fun With Pictures of Your Friends

IF you would like to have a little fun with your friends, try enlarging a group negative or single figure after this fashion: First place the negative in the enlarging frame in the usual manner. After the desired size of print has been decided upon and focus made for size, tip the frame or sliding-board (on which sensitized paper is placed) gradually backward, until the persons or scenes assume fantastic shapes. The best angle of the board will probably be around forty-five degrees, although some negatives require a greater angle to change them.

A print from the negative of your thin friend will reveal him as a very stout person, but without losing the facial likeness in the process. By tipping the board backward, everything seen in the

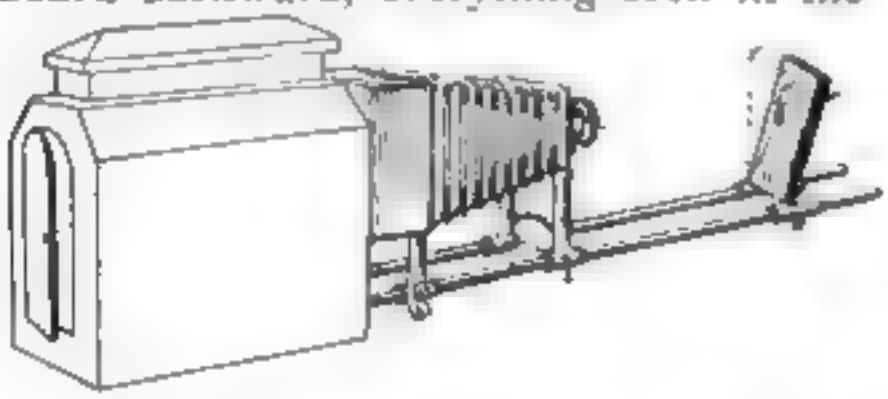


Diagram showing the arrangement of the sliding-board for making trick pictures

negative, is lengthened, so that the fat man becomes a tall, thin person and a stubby tower becomes a factory chimney.

The length of exposure needed will be found to be about the same as when the board is in the normal position. Duration of exposure depends on the size of the stop used. It is not necessary to own an expensive enlarging outfit, since the trick can be done on anything from a "Brownie" to the professional apparatus. Try it on your friends.

If the tilt of the board is the length of the picture, thinness becomes an attribute of all

Tip your sliding-board at forty-five degrees sidewise and you make the whole world rotund and happy

A Metal-Vapor Light That Is White

A NEW vapor lamp employing the vapor from metals has been patented by a German scientist. Zinc chloride and zinc bromide have been used and give the best results at atmospheric pressure. As in the mercury-vapor arc, the inclusion of air or other foreign gases in the tube is prejudicial. On the other hand, an arc in an atmosphere of aluminium chloride or titanium chloride is more stable, and an admixture of nitrogen is harmless. Oxygen, however, must be excluded. It is stated that the color of the light is white, and that the efficiency is in the neighborhood of that of the mercury-vapor lamp.

The fact that the light is white will greatly add to the importance of the lamp, since there are many uses which demand such illumination.

What Wind and Rain Can Do

How Nature's Chisels Work Through Millions of Years

ON the sloping "shores" of the great salt-incrusted playa at the bottom of Death Valley, California, which is the bed of an ancient lake, there is a large volcanic rock which, it is stated, has appeared to grow out of the ground several feet within the memory of the pioneers. When first observed, this was simply a large irregularly-shaped rock resting on the ground. Since then it appears to have been pushed upward. It is supported on a fragile, wedge-shaped neck not over a couple of feet broad. The apparent instability of the thin neck with its top-heavy burden is accentuated by a good-sized hole in its middle, so that in traveling the trail which passes directly under the rock, the tenderfoot is apt to feel relieved when the formation has been left behind.

Contrary to supposition, there has been no growth or uplift of this rock. The earth at its base has been washed and blown away by the winds and the cloud-bursts, which, on rare occasions occur even in this intensely desert region, sweeping everything before their great volume of water.

On the opposite page is pictured another product of wind and rain, probably one of the most singular collections of rock figures in existence. Acres and acres in extent, from a distance they resemble, as much as anything, a vast family or colony of gigantic prairie dogs sitting on their haunches, and covering the entire slopes of Red Mountain, Arizona. The figure of the man in the left center of the photograph indicates the size of these "prairie dogs."

Mushroom Rock—one of Death Valley's curiosities

This mountain is a cinder cone of the San Francisco plateau, and the village of rock forms has been caused by the cutting and sculpturing of the soft lava by the wind and rain. The cinder cone of a volcano is the last upheaval, the result of the dying gasp of eruption. So stupendous, however, has been the dynamic energy attending many of the earlier volcanic disturbances of the West that there are cinder cones several thousand feet in height.

Sculptured by the Elements

Many acres are covered with these giant ninepins of soft lava Of colossal size, as shown in contrast to the human figure, they resemble, from a distance, a vast colony of prairie dogs sitting on their haunches

Amputating Pittsburgh's "Hump"

THE "Hump" in Pittsburgh was a hilly prominence upon which stood the County Courthouse. Adjoining it were the Frick, Carnegie, and other large sky-scrapers. It impeded travel. Hence it was decided to remove the "Hump." This involved the cutting down of fifteen thousand feet of city street, and affecting twenty-two important city blocks.

In this district thirteen public service corporations had underground conduits, cables, pipes, etc.

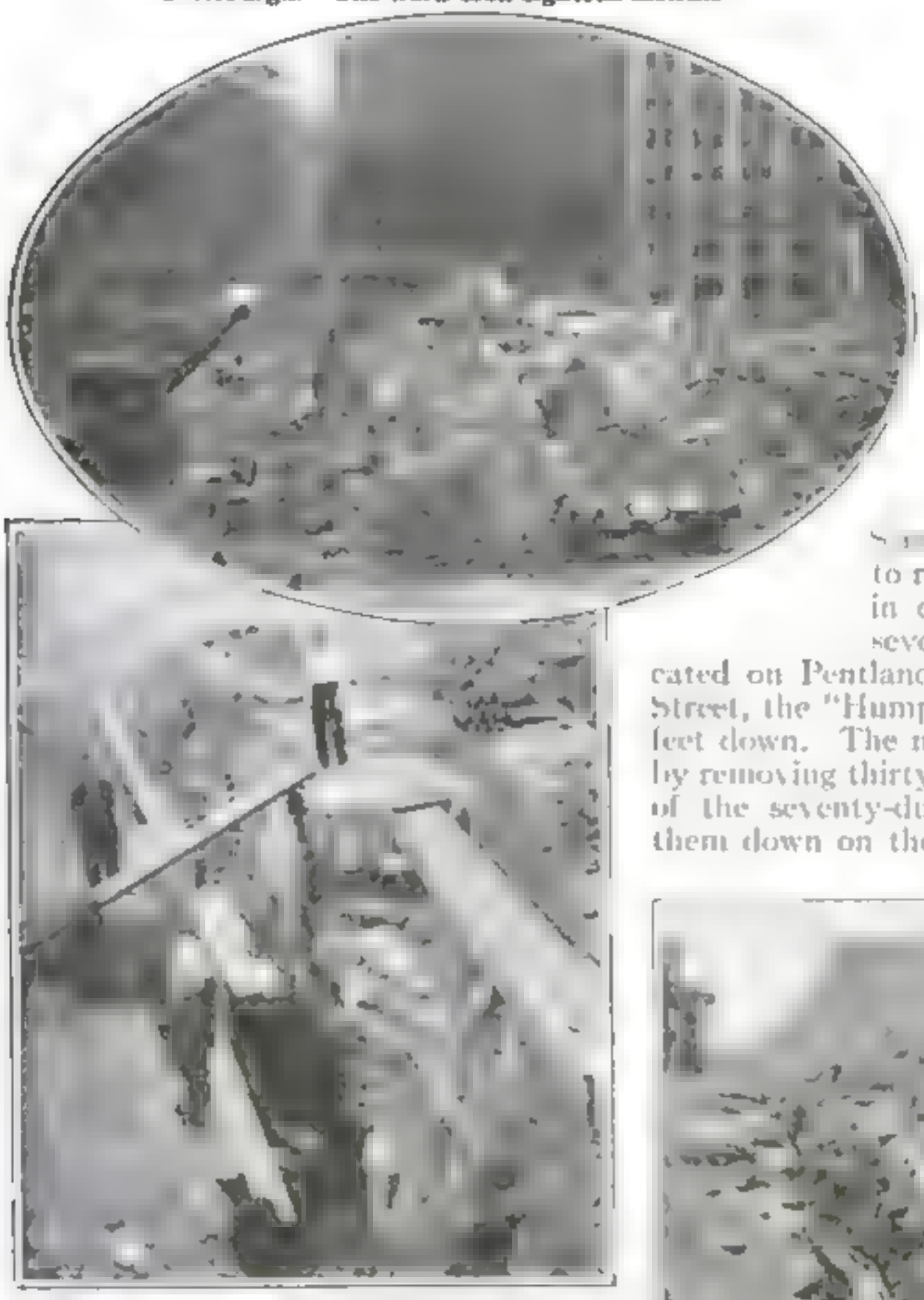
In the business section of most large American cities the overhead wires and cables have been so effectually placed underground that nothing reminds us of the mechanism whereby water, gas and electricity are supplied a few feet beneath the surface of the street.

How the cables carrying most of Pittsburgh's telephone conversations were taken care of until the new conduits were ready for use

Particularly difficult was the task of maintaining in operative condition seven thousand, two hundred paper-insulated cable wires contained in lead cable-sheaths. These cables, twenty-one in number, were originally drawn into vitrified clay conduits and spliced in manholes located at the street intersections. When the cutting of the "Hump" proceeded and the street was down to the level of the conduits, it was found that the drilling and blasting in the immediate vicinity shattered the conduits, so that further excavating would cause the conduit line to collapse. The clay conduits were broken off the cables and the cables were planked up in a box or trough. Alongside the plank box was the trench, twenty-two feet deep, in which a conduit line was to be constructed by what is known as the "split duct" method. These special conduits are scored lengthwise inside and outside before being vitrified or baked and can be easily split in two. After a layer of half-ducts is laid in cement, it is possible to place the cables in position and replace the top halves of the ducts.

This procedure of lowering the telephone cables into split ducts saved about $40,000 which would have been expended in purchasing new underground cable to be pulled, spliced and cut into service, to say nothing of the occasional interruptions of service and confusion in transferring the working lines from the old cables to the new ones. The cables thus lowered below the new grade of the "Hump" cut contained three thousand, four hundred and eighty-one miles of copper wire, paper-insulated, twisted into pairs and enclosed in a lead sheath. The time required to accomplish

The "Hump" cut passed through the very heart of the City of Pittsburgh. The work took eighteen months

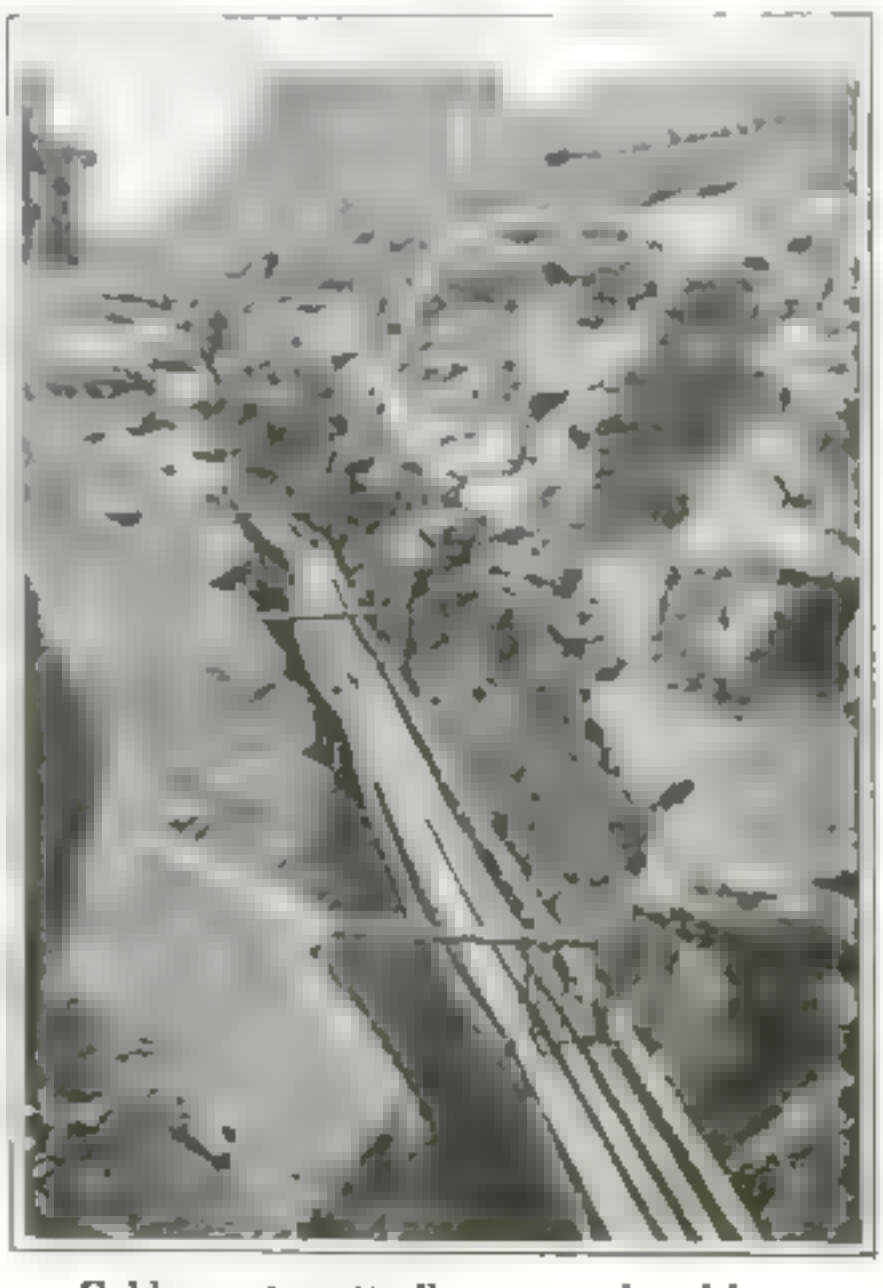


Cables were placed in a plank box, shown at the right. The ditch is twenty two feet deep, cut mostly through blue rock and limestone by means of steam drills and dynamite

the work was eighteen months, costing the telephone company about $75,000.00.

This is the largest job of the kind ever attempted and successfully accomplished. At the rear of the telephone company's main exchange, located at 7th Avenue and Grant Boulevard, there is a central cable vault or underground room about eighteen feet square, extending out under the street, from which radiate in various directions the underground conduits leading to different parts of the city and to the basements of the large office buildings.

The particular conduit line leading into the "Hump" district which had to be rebuilt contained seventy ducts where it left the central vault, thence sixty ducts in Strawberry Alley, and branched out via Grant Street, Oliver Avenue, Diamond Street and Tunnel [illegible] It was necessary to rebuild the cable vault in question. Where the seventy-duct line was located on Pentland (formerly Fountain) Street, the "Hump" cut was only a few feet down. The new grade was cleared by removing thirty-five ducts off the top of the seventy-duct line and building them down on the side, thus making a



Cables systematically arranged and hung in the trench preparatory to being lowered into the split ducts

Laying the cables into split ducts without cutting or drawing through conduits as usual. The ducts used were the usual vitrified clay, but before baking they were scored inside and out, and easily split open by the brick layer

The cables are in the ducts and the concrete which will seal them is about to be applied. The split conduit was a new idea but it allowed for the "laying" of the cables instead of drawing them through the pipes

conduit line ten ducts wide and seven ducts high

The work was carried on in the heart of a great city, and also in the midst of the added confusion of tearing down old and erecting new buildings

In the transfer of cables from the old ducts to the new, the fact that this could be done without splicing and consequent interruption of service was particularly important. The long distance cables, moreover, were composited for the simultaneous working of telephone and tele-

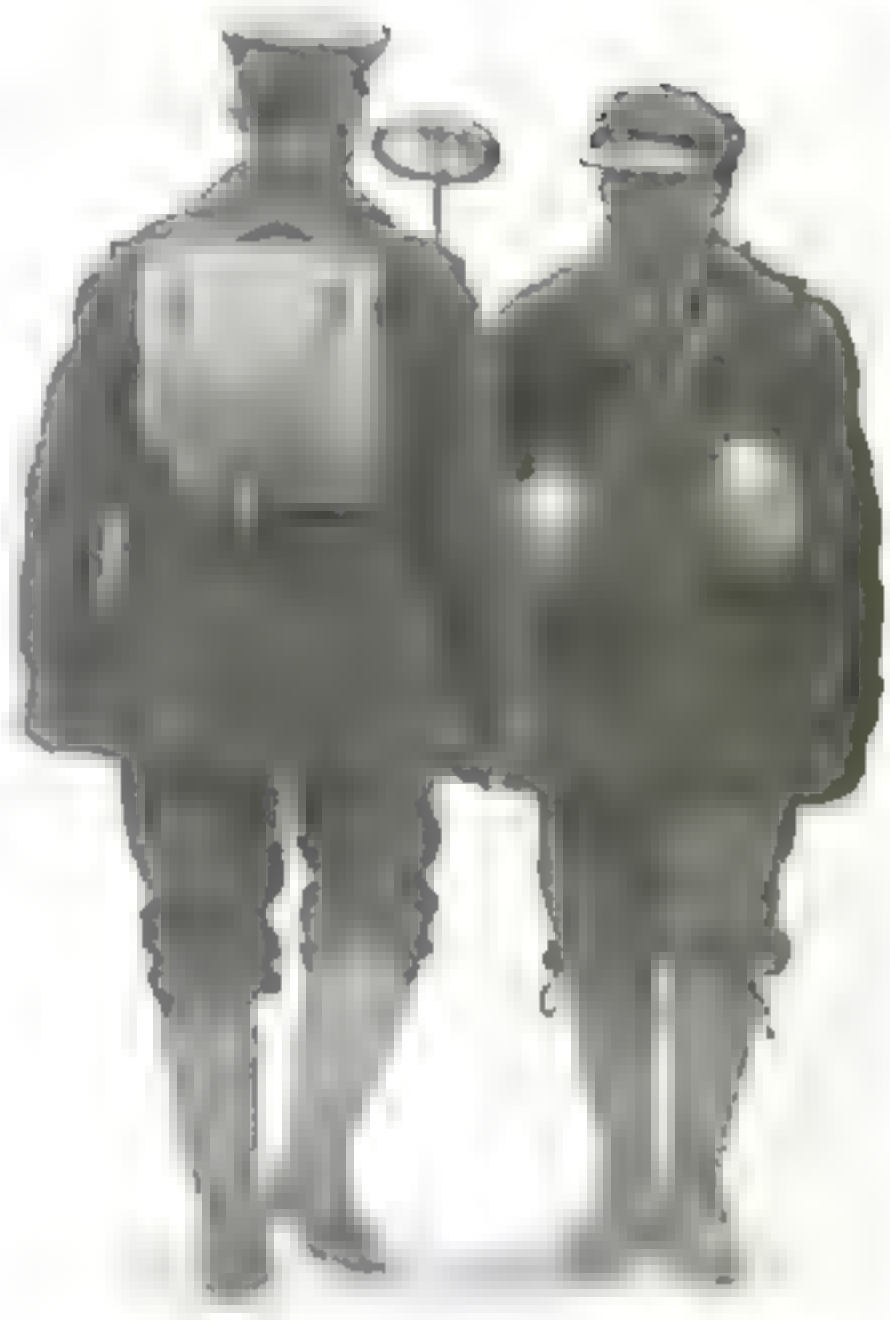
The only cable cut. It was necessary to do this to get around an obstruction There were 800 wires to be cut and spliced individually

graph, or else carried additional phantom telephone circuits superimposed upon the physical circuits. The cutting of these cables, which was the usual thing to do, would have entailed not only expense, but interruptions more serious than on the local service.

Walking Backwards Across the Country

A WALK across the continent backwards is the task set himself by Patrick Harmon of San Francisco, who expects to reach New York in July. Mr. Harmon is fifty years old, and is making a schedule of fifteen miles a day. He walks the whole distance to the East with his face to the setting sun, and the traditional wager of some $20,000 is to be won on arrival in New York within two hundred and sixty days set for the trip.

The whole route of his walk, 3,000 miles, is to be made with his face to San Francisco and his feet moving toward New York. Mr. Harmon uses a mirror, hung on a special frame, to guide him on his way, and is accompanied most of the time by walking companions.



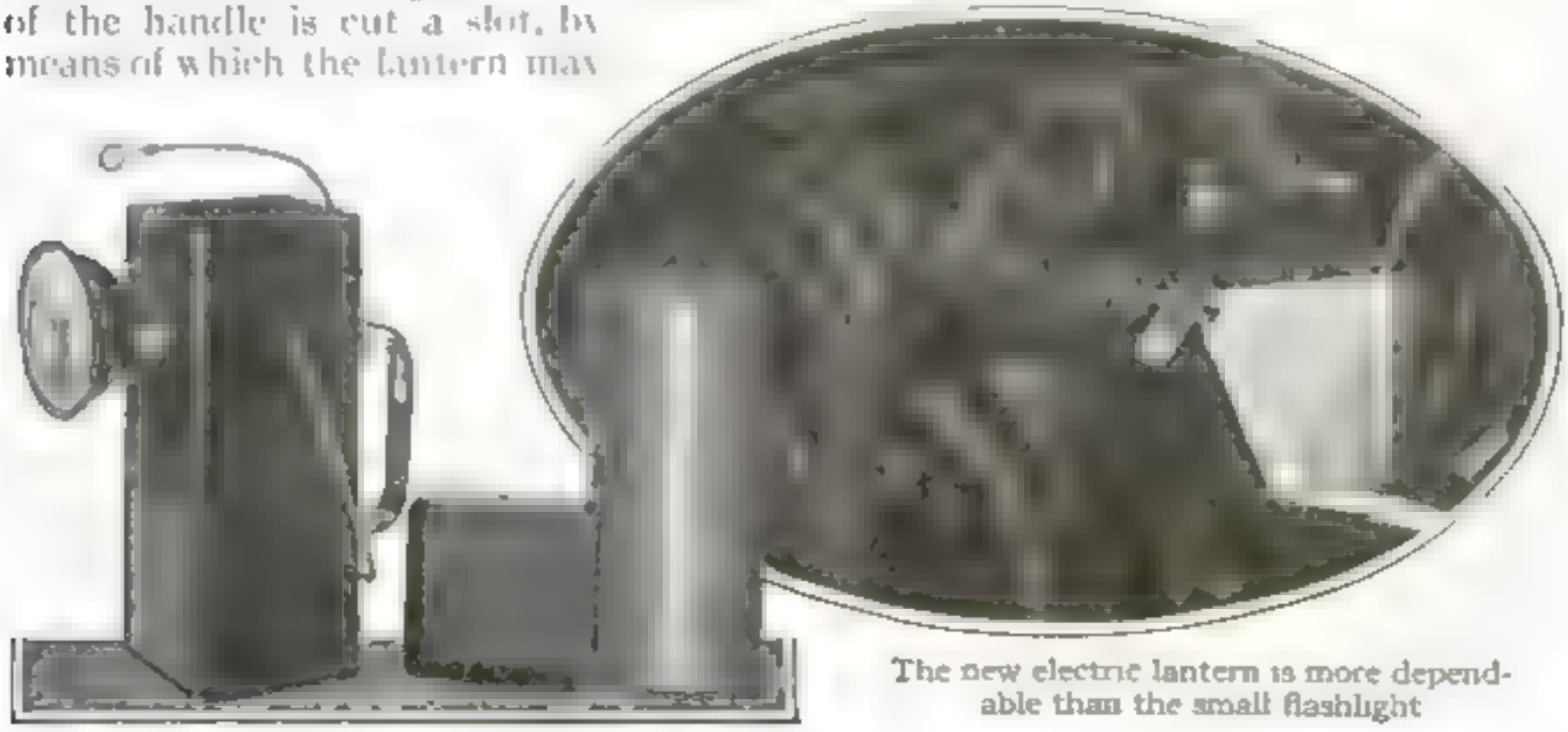
This man needs the mirror to see where he is going, for he is walking backwards from San Francisco to New York

A Convenient Flashlight for the Automobilist

A STURDY electric lamp which obviates the difficulty of searching for special shapes of batteries to fit it, has recently been placed on the market. An ordinary dry battery furnishes the current.

Two handles are affixed to the battery box, one of which is similar to the handle found on the old-style oil lantern. The other handle is close to the side of the lantern, and enables the user to manipulate the light in limited spaces. As shown in the illustration, this handle makes the lantern very serviceable as a motorists' "trouble light." In the side of the handle is cut a slot, by means of which the lantern may be readily hung on a nail or hook.

This light will be found serviceable especially for watchmen, farmers and others who formerly employed a smoking, flickering kerosene lantern, which is liable to go out when most needed, and which always carries with it a certain amount of danger



The new electric lantern is more dependable than the small flashlight

A track surfacing and tamping gang on the New York Central. The compressor car is mounted beside the track to furnish compressed air to the tampers

Tamping Railroad Ballast with a New Air-Tool

A GOOD roadbed is one of the greatest assets of a railroad. There is almost as much difference between riding over a well and a poorly maintained roadbed as between jitneying over an asphalt and a cobble pavement.

Tamping the crushed-stone ballast underneath the ties is particularly difficult. Formerly tamping was done by hand with the aid of a pick or a long bar with a blunt end. Now, many of the progressive railroads use a novel type of pneumatic tamper. In tunnels and terminals, where compressed air is employed for operating electro-pneumatic signals, it is simple to connect the tools with the compressed-air pipe line by means of a hose. For work out on the road, where a supply of compressed air is not available, air is supplied by a small engine-driven compressor, mounted on a special car. The gasoline-engine also drives the car.

An interesting feature of this car is the method of quickly derailing it and placing it beside the tracks. Four small wheels are set at right angles to the main wheels. By placing a few lengths of timbers under these wheels, the car can be run off the track in a few seconds. Electric railroads employ a similar type of compressor-car, with an electric motor instead of a gasoline engine to run the compressor.

The men generally work in pairs on opposite sides of the ties

The pneumatic tamping machine works on much the same principle as the familiar pneumatic riveter. A piston or hammer delivers eight hundred sharp blows per minute on the end of a tamping bar, which is inserted in the nozzle in the lower end of the tool and which is locked in position. The bar cannot be knocked out, yet the operator can shift it from one position to another.

The tampers are usually worked in pairs on opposite sides of the tie. The face of the tamping bar presses against ballast beneath the bar under and to the center of the tie. This actually lifts the tie and track as much as may be desired, and packs the ballast tight. The blows are light; consequently the ballast is not broken as much as with hand tamping and less damage is done to the ties.

The New York Central found that its savings by changing from hand tamping to pneumatic tamping amounted to over $150 per mile of track.

Destroyers of the Air

By Eustace L. Adams

(Continued from the March Issue)

The first real aeroplane squadron of the United States Army, consisting of eight one hundred-horsepower Curtiss tractor biplanes. These machines are good American designs, showing European influence in the streamline fuselages, disk wheels and other details

EVEN before the advent of *Fritz*, the great German biplane, which for a brief time drove its adversaries from the skies, the Allies were working upon the plans for aerial battleships. One of the results is a French biplane with a wing spread of about seventy feet. Her wings tower thirty feet from the ground; her crew numbers twelve; her guns are two, and they throw three-inch high-explosive shells. By reducing the crew a great number of heavy bombs may be carried. The new machine is a welcome addition to a bombing foray over German territory. This battle-plane has held its own with *Fritz*, and is accredited with having done much damage during the recent French raids on Freiburg and German towns of military importance.

Twin-engined machines are now common on both battle lines. Machines with two guns no longer arouse interest. Aeroplanes mounting a single gun and one motor are scouts, for the most part, which need great speed and slight armament. A speed of well over one hundred miles an hour is not at all unusual for these machines, which correspond with the swift "destroyers" of the navy.

To fight off these heavy scouts, battle-planes are required, the best known of which is the German Fokker monoplane, which at first created consternation among the British aviators. This machine is a very high-powered monoplane, resembling the French Morane. The wing spread is very small and the planes are flattened, yet a two hundred horsepower motor is mounted on the fusilage. Speeds of one hundred and thirty miles an hour are said to be attained by this wasp-like machine. A single machine-gun is mounted in the bow, and is operated by the pilot. Owing to the need for lightness of weight, small fuel tanks are carried and the machine does not stray far from its hangar. When an enemy flyer is sighted, a Fokker rises, and because of its superior speed, can maneuver to any position it likes. It usually climbs far above its foe, and then, with engine at full speed, dives straight at its opponent, with its machine-gun blazing fire. The only hope of the Allied aeroplane, taken at a disadvantage from above, lies in a quick, twisting dive, followed by rapid flight for the protection of friendly anti-aircraft guns. The Fokker is essentially a machine for fast, decisive fighting, and because of its almost total lack of inherent stability, requires an expert aviator to operate it. The British, since the disastrous *début* of the Fokker as a fighting machine, are said to have evolved a monoplane which will successfully compete with it.

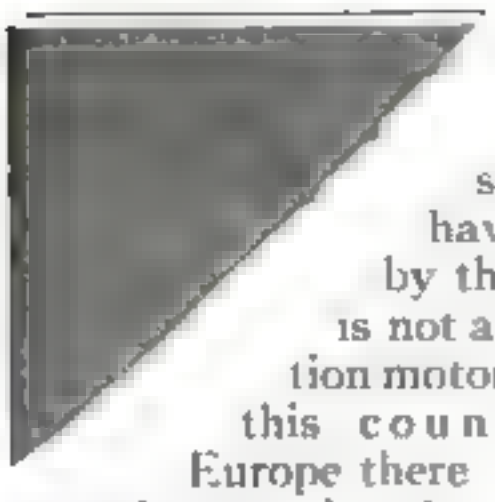
One of the most important of all these new machines has been built in this country, at Boston, Mass. The Sturtevant battle-plane is entirely of steel, and is a biplane of tractor type built with a remarkable simplicity. The steel con-

Courtesy of Illustrated London News

Capable of accommodating sixteen passengers, or of carrying a heavy cargo of bombs, the Sikorsky biplane was the first aeroplane to be built of gigantic dimensions. At the outbreak of war this machine was the largest in the world, but its usefulness was handicapped by its

struction that has been used consists largely of steel tubing, and the best practice in bridge work and structural engineering has been introduced, for the first time in aeroplane construction. All parts are interchangeable, and with the proper machinery, the aeroplanes can be manufactured in great numbers with great speed and at a very low cost. With this type of construction, machines of great size may be built which will have an unusually large factor of safety and great inherent stability.

The first model of the Sturtevant all-steel battle-plane has a so-called turret (in reality a stationary streamline body) half-way out on each wing. In these turrets may be mounted heavy guns, and in time of peace they may be used for passengers or freight. The first trials of this new machine were most successful, and the designer, Grover C. Loening, former Aeronautic Engineer of the United States Army, has been awarded a medal by the Aero Club of America for his meritorious work.



At the present time, aeronautical designers in America have been hampered by the fact that there is not a dependable aviation motor manufactured in this country to-day. In Europe there has been a great advance in the manufacture of aeronautical motors, chiefly because several automobile manufacturers turned their attention to this phase of the motor industry. Firms with international reputations for motor designing, such as the Mercedes in Germany, the Rénault in France and the Sunbeam in Great Britain, have designed aeronautical motors which are giving the greatest satisfaction under the most difficult war conditions.

Until very lately the aviation motors made in this country have been manufactured by companies which had little or no previous experience in motor designing. The Packard Company has designed a promising twelve-cylinder aviation motor, and the Simplex Automobile Company is equipping the rejuvenated Wright Aeroplane with a well-designed and carefully built motor, which in its first tests has justified the hopes placed in it by its designers.

When automobile manufacturers cooperate with aeroplane builders and succeed in developing an aeronautical motor which is as dependable as the automobile motor of to-day, the most formidable obstacle in the path of aviation will have been overcome.

If the war has accomplished no other useful end, it has advanced the progress of aviation many years. In the United States, without the spur of military and naval aeronautics, aviation was regarded as a profession from circus performers, whose main duty was to "loop the loop," and provide thrills for the crowds. Now, with aircraft manufacturers turning out aeroplanes at the rate of sixteen a day, the public is beginning to realize that it is a remarkably healthy infant industry, closely rivaling the unprecedented growth of the automobile industry in its early stages. One of the foremost aeronautical experts in the country recently said to the writer:

"Within one year after the signing of peace between the European powers, the first aeroplane will make a successful flight across the Atlantic Ocean. Very soon aeroplanes will be carrying our mails to inaccessible spots. Shortly after this will come the carrying of passengers on a schedule as regular as that of our Twentieth Century Limited. Many of us will live to see the aerial expresses with many planes, multiple engines, and an enormous carrying capacity, which will take us to San Francisco or even to London and Paris as easily as we can now ride to Kansas City."

slow speed—a fault which has probably been remedied by now. The huge size of this aerial craft is shown by comparison with the men standing beside it. Remember that there are some aeroplanes now flying which are even larger than the one here pictured

A Judge Who Has Succeeded Without Arms

OCCASIONALLY one meets men whose determination to succeed regardless of obstacles makes those obstacles act only as added stimuli to their progress. Such is the case of Judge Quentin D. Corley of Dallas, Texas, who ten years ago lost his entire right arm and his left arm above the wrist. With this handicap, many men would sink into a life of helplessness, however unwillingly. Judge Corley proceeded to study law, in the meantime earning a living for himself as a superintending contractor. At the end of a year he had devised a hook with which he could write and do many things. At the end of the second year he had been admitted to the bar, and in seven years from the date of his accident he was made County Judge of Dallas County.

Armless Judge Corley can put on his own necktie, as well as dress himself alone. He didn't learn to shave, merely because that hardly seemed worth while with barbers willing to help him

Judge Corley has now perfected a mechanism with which he has made himself independent of outside assistance. He is able to use a telephone, pick up large and small articles with ease, take money from his pockets, turn doorknobs, bathe himself, lace shoes, use a toothbrush, handle a knife and fork, and put on or take off his collar and necktie. But this is not all. He can do things which many men with both arms have not learned to do, such as swim, dive, bowl, drive a horse, and run an automobile. The accompanying illustration shows Judge Corley seated in his automobile, with his foot on the throttle and his mechanical hand on the wheel. He cranks his machine and, in fact, takes entire care of it.

Judge Corley is a young man who feels keenly the needs of a cripple. His attention is now directed to Europe. His plan is for each government to establish a temporary institution where cripples may be taught a trade or profession and the use of mechanical hands. The expense to the government would be remarkably small in comparison to that of maintaining permanent institutions for the care and support of cripples.

Judge Corley can run his automobile alone, and does it because he likes to

The Allies' Losses

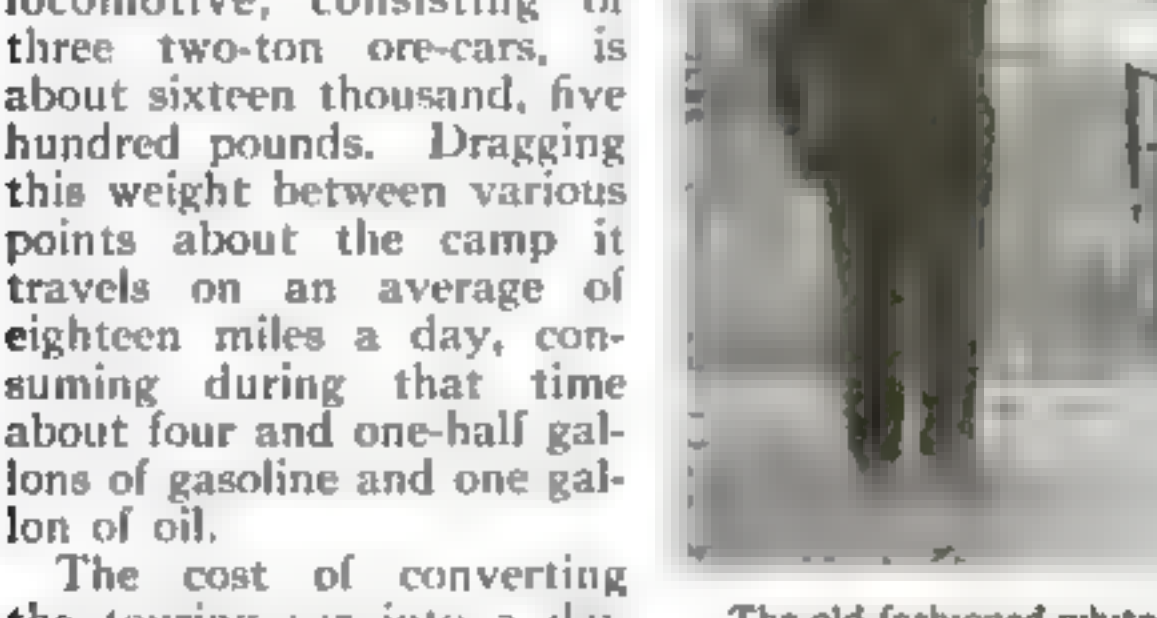
RECENT information, believed to be correct, gives Allied losses in the European War until January as follows: Total British casualties, 549,467, including 24,122 officers; French total, 2,500,000, of whom 800,000 were killed, 1,400,000 wounded and 300,000 captured. It is estimated that nearly sixty per cent of the wounded return to the trenches. Official figures regarding the Teutonic losses are unobtainable.

An Automobile Converted Into a Railway Ore-Tractor

A FORD automobile which was fast reaching the end of its usefulness in a mine in Texas was recently knocked apart, put together again on a short, heavy chassis, and mounted on railroad-wheels for use on a narrow-gage track. Although the automobile had been driven more than twelve thousand miles, it fell to its new task with a will and has been behaving admirably ever since.

The weight of the full load pulled by the improvised locomotive, consisting of three two-ton ore-cars, is about sixteen thousand, five hundred pounds. Dragging this weight between various points about the camp it travels on an average of eighteen miles a day, consuming during that time about four and one-half gallons of gasoline and one gallon of oil.

The cost of converting the touring car into a day laborer was one hundred and fifty dollars.



A Ford automobile which was converted into a mine locomotive at a cost of one hundred and fifty dollars

Stopping the Speeder with a New Danger Sign

A DISTINCT novelty in safety devices is now being tested on nearly one hundred grade crossings of the New York Central Railroad. Upon the approach of a train, the watchman, instead of waving the customary white flag, holds in the air a white sign, across the face of which is painted the word "Stop" in staring red letters. The warning is painted on both sides of the novel signal and is visible at a considerable distance in either direction.

The officials of the railroad feel that the sign will be more effective than the familiar flag. If the experiments prove a success, the new device will be used at all grade crossings on its system. At night a red lantern with the word "Danger" painted on the red glass will be used.

The old fashioned white crossing flag having outlived its usefulness, the New York Central now uses a big white disk with "Stop" painted on it in red

Italians Build Highest Powered Motor Ship

AN Italian shipbuilding concern has recently completed the construction of the world's highest-powered motor-ship. This record-breaking craft, designed for the Brazilian Navy, is a submarine depot-ship, three hundred and twenty-six feet long, and propelled by two Diesel engines, each of three thousand two hundred horsepower. It is rumored that the ship will not be delivered to Brazil, but will be used as an adjunct to the Italian submarine fleet at least for the war.

A burl that looks like a leg

Pranks Played by Trees

BURLS are abnormal growths common to almost every species of tree. They are produced as a result of some injury, such as forest fires, insect attacks, gnawing of animals, or excessive pruning. The effect of the injury is to stimulate the growth of dormant buds or to give rise to a great many new ones which cannot develop into branches, but do form a gnarled and interwoven mass of woody tissue of very intricate design.

This unnatural growth is very dense and hard. In most trees it is very small, but in the case of the redwood, the largest tree that grows, it reaches a size which makes it of value.

Nature grew these legs on a tree

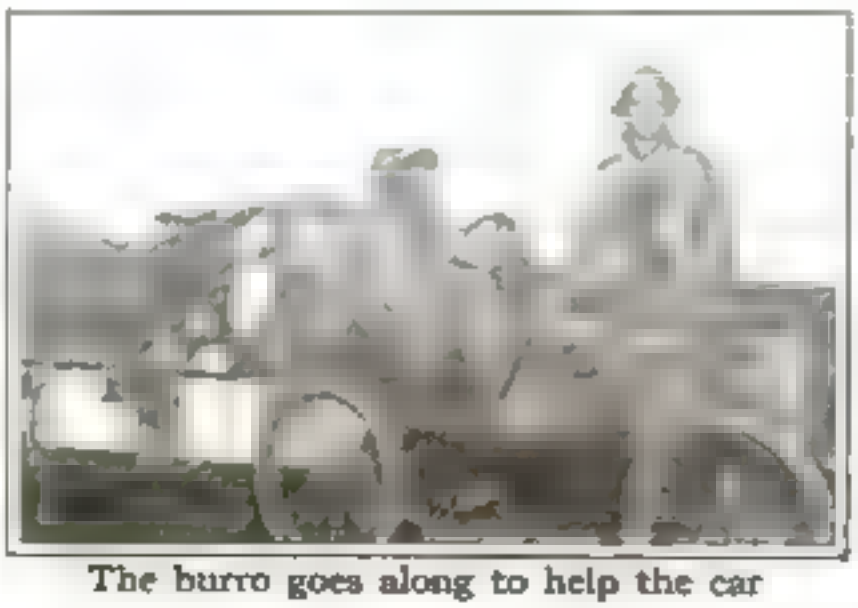
Giant Ladle for Molten Cinders

A GIANT ladle for carrying away molten cinders from the furnace of a Maryland steel company has recently been cast, weighing nineteen thousand, seven hundred and ten pounds. A fair idea of the proportions of this huge ladle can be gained by a comparison with the figure of the man who is standing in it. It is ten feet in diameter and nine feet deep.

A ladle to hold the cinders of a steel furnace

With a Trans-Continental Burromobile

A TRANS-CONTINENTAL "burromobile" recently made its appearance in Los Angeles, California, after having crossed the country, from the Atlantic to the Pacific. The speedometer on this machine showed that more than five thousand and forty-two miles had been covered, and John A. F. De Lion, the driver, tells us that he is not yet ready to "settle down." In the accompanying picture John, the owner of the car, is seen seated in the machine, the boy who is standing is a traveling companion; while Jack, the four-footer behind, is the means by which this car has been "lifted" from many a sand-hole and out of mud hub-high.



The burro goes along to help the car

John started from Philadelphia on June 30, 1912, and throughout the intervening time he has been on the road. The route selected led John to New York, Chicago, Omaha, Denver, El Paso, Phoenix and San Diego. He expects eventually to tour the entire length of California and even to proceed farther up the Pacific Coast.

The donkey, strangely enough, goes behind the car.

Mahogany Steamboat Cabin for a Home

The mahogany cabin of a topheavy boat now does duty as a cabin

WHEN the steamer "Lilian" was built her designer had her fitted out with a solid mahogany cabin, made of the heaviest and finest mahogany wood obtainable, only to discover when she was launched that she was topheavy. It was necessary to remove the expensive mahogany cabin and dispose of it. Accordingly it was sold to an eccentric resident of San Diego, who hauled it up the steep embankment to his vacant lot and lives in it.

The cabin makes a fine little bachelor home and is spotless in its polished splendor without and within. The heavy French plate-glass windows and Venetian blinds also add a note of distinction. Several reminders of the sea are still present inside the cabin-home.

A Giant Pair of Scissors With a Symbolic Meaning

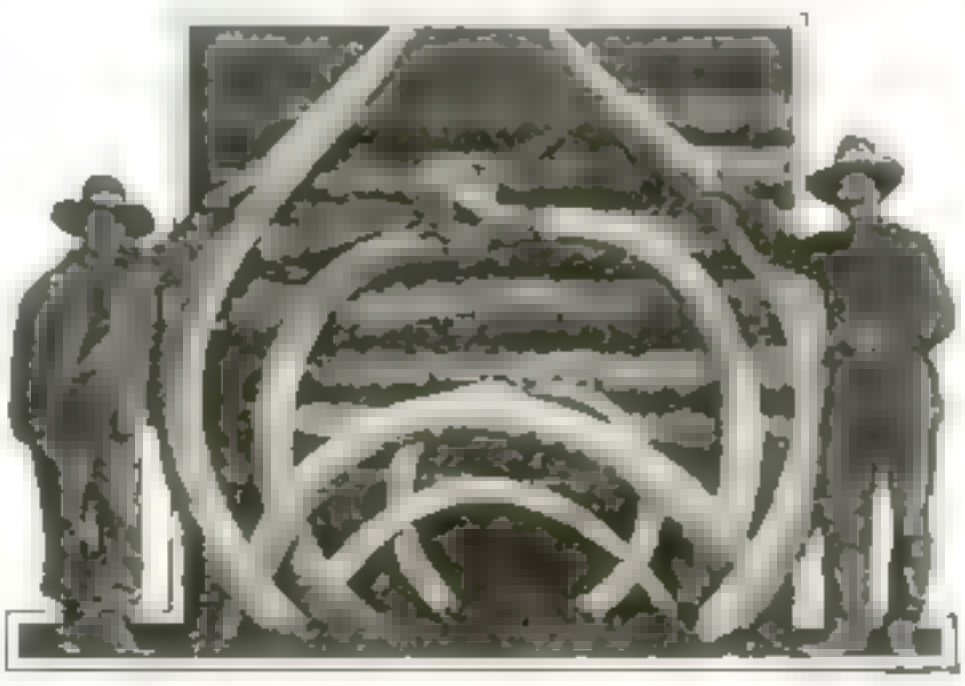
Joe Stecher, the wrestler's, scissors are longer than his legs, but not so mighty

JOE STECHER of Dodge, Neb., owns the largest pair of scissors in the world. Also he possesses the greatest scissors grip in his powerful lower limbs. It is that scissors grip of his which has made him famous as a wrestler.

Recently the friends of Joe Stecher gave him a big celebration at his home, and presented him with a three thousand dollar diamond-studded belt. One of the notables of the state, invited to address the assembly on that occasion, spent no time preparing a speech about a diamond belt, but instead went to a big manufacturing plant and ordered a pair of shears eight feet in length. The factory put men to work and worked them overtime to produce the monstrosity of cutlery.

When this speaker, Colonel James C. Elliott of West Point, Neb., was introduced, he presented, not the diamond belt, but the giant scissors.

Mammoth Tusks from Alaska

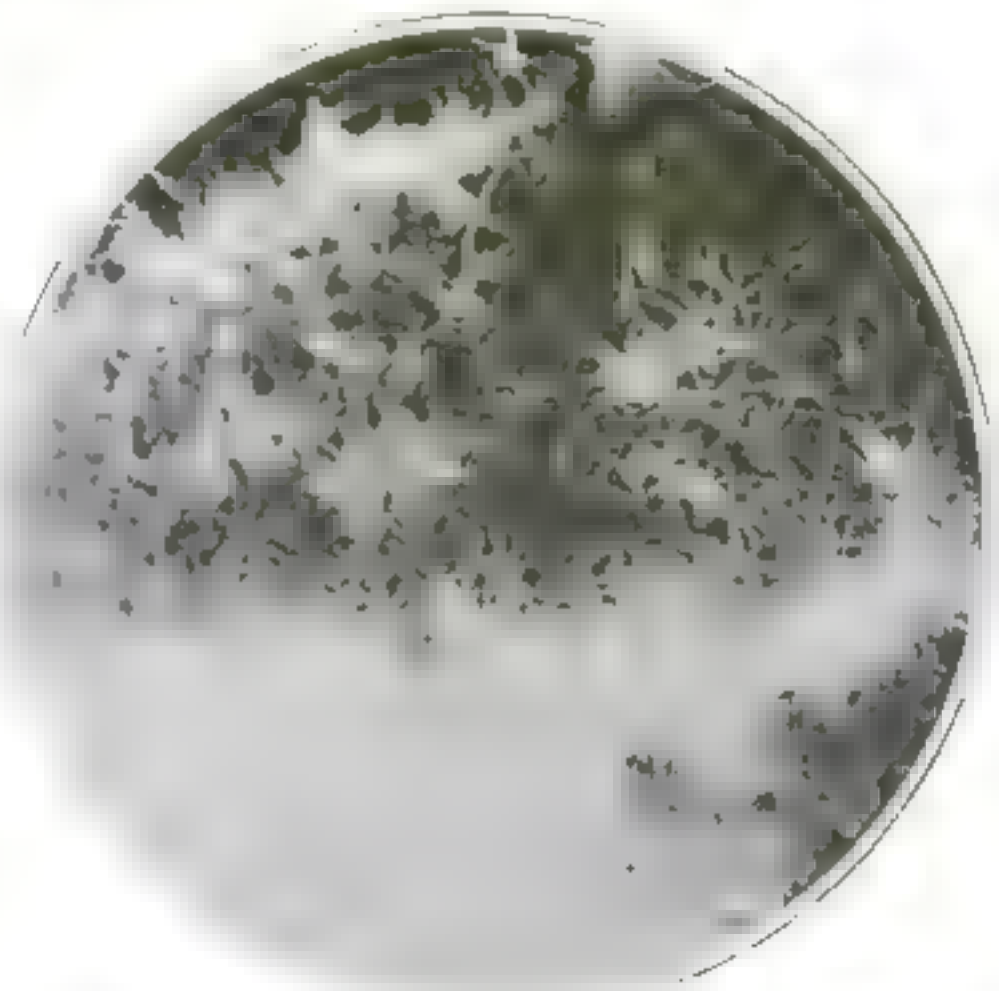


Enormous fossil tusks from Alaska

THE huge mammoth tusks shown in the photograph were dug out of the earth at Silver Creek near Dawson, British Columbia, just across the boundary from Alaska. They are far larger than the tusks of the greatest of modern elephants and the animal who swung them must have been a giant even among mammoths. The buffalo skull and horns seen in the center of the picture, large as is its massive head, show by comparison how huge must have been the head of the mammoth.

How Blotting Paper Absorbs Ink

EVERY student of physics knows that water will run up a narrow tube by capillary attraction. Anything immersed in water has a similar attraction for the water; that is, the object becomes wet by the water that clings to it. The amount is limited by the weight of the liquid itself. Place your hand in water, and your hand, when withdrawn, is wet. The limited attraction between the hand and the water is gaged by the weight of the water that clings to the hand.



Blotting paper absorbs ink on the same principle as a handful of hay will absorb a liquid

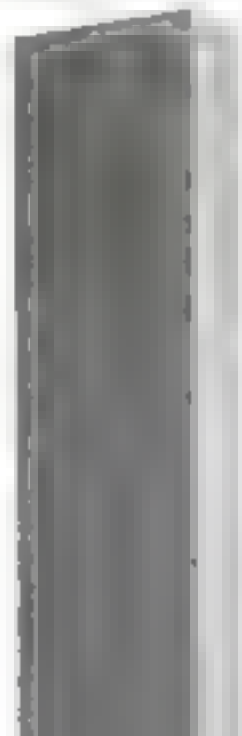
Imagine several hands placed close together in water, but not touching one another. If this composite hand were formed of ten single hands, it would attract ten times as much water as the one hand would attract and hold on its surface. So, a wisp of hay, composed of a hundred spears of dried grass, placed in water, will remove a hundred times as much of the fluid as would cling to one spear. Bushes in a marsh will remove a certain amount of water which will, by capillary attraction, cling to their submerged parts.

Under the microscope, fibrous blotting paper, when absorbing ink, resembles, on a small scale, a marsh matted with shrubs and sticks and twigs, around which water is flowing as ink runs about and among the fibers that together form the spongy paper. There is a limit to the amount of liquid which a "blotter" will absorb, as there is a limit to the amount of water that a marsh will absorb without overflowing. That limit, in the "blotter," is the combined capillary attraction of the fibrous shrubs and sticks and twigs that together form the paper.

Balsa, Lightest of Woods

EXPERIMENTS made by the Missouri Botanical Garden of St. Louis show that the wood called balsa, native to the West Indies and Central America, is nearly twice as light as cork.

In the photograph a piece of balsa-wood (B) is balancing a piece of Australian ironbark (A). The two blocks have the same width and thickness, but *B* is ten times the length of *A*.

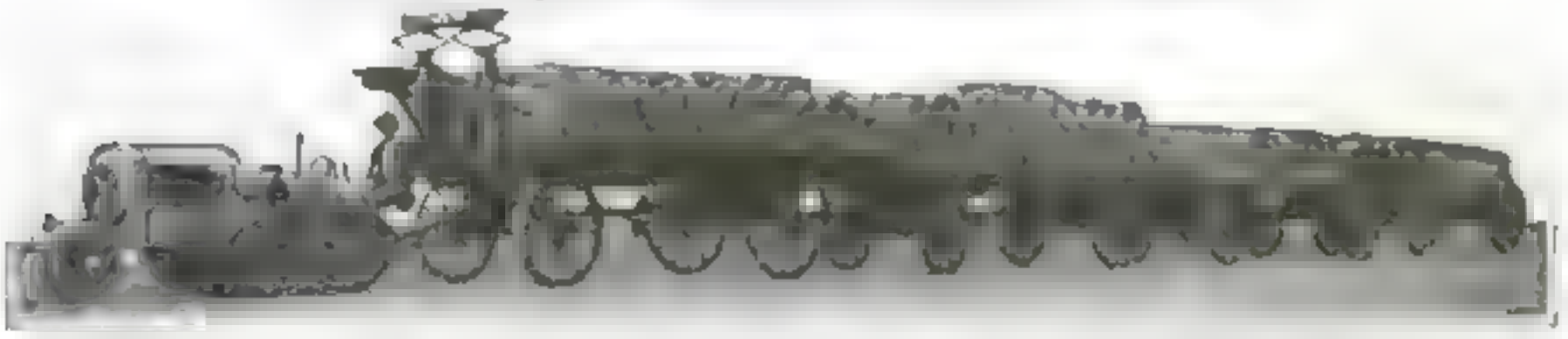


Balsa, on the right, is a wood ten times as light as ironbark, on the left

Balsa is very soft. It is easily cut with tools, and is imported into the United States from Costa Rica to make the floating parts of life-preservers and life-rafts. The government uses it for buoys and water signals. It has several advantages over cork.

Gasoline Horses for Small Farms

Is the Small Tractor Here at Last?



An eighteen-horsepower tractor hauling barley over a smooth California highway

THE amazing popularity of the small gasoline engine and the motor-car on the farm—even the motor-truck where introduced—makes it seem perfectly natural that the internal combustion tractor should pull the plow and take the place of the horse in all field work on the average farm. But the history of agriculture for nearly eighty years has shown that the general application of mechanical power to the working of the soil is a problem far more difficult than the use of motors in stationary work or road transportation.

The problem, however, is apparently near a solution, and the year 1916 may see the practical fulfilment of an ideal that has occupied the minds of thousands of inventors, *i. e.*, the production of farm tractors mechanically and economically suited to the average farm, as well as to the great ranches of the West and Northwest.

Steps in the long evolution may be set down in order:

1770 Cugnot's road locomotive.

1800 1825 Development of steam road locomotives and their practical legislation off both American and English highways.

1858—Fawkes' steam plowing engine in Pennsylvania.

1870–1875—Adoption of the differential gear and friction clutch

1875–1890—Development of the steam threshing engine, self-propelled

1890–1905—Development of large steam plowing tractors.

1903—First commercial gas-tractor

1910–1912—Gas-tractors actively displacing steam for plowing on a large scale.

1913—Success of the power-lift plow cuts crew of plowing outfit to one man, and makes smaller tractors profitable.

1914—Amazing variety of small tractors produced, following virtual collapse of market for large tractors and constant increase in the cost of horse and man labor.

1915—Numerous tractor demonstrations throughout the Middle West focus attention of hundreds of thousands of farmers upon light tractors pulling two or three plows.

1916—Will see thousands of these small tractors, with the improvements suggested by one or two seasons' work, put to practical test by farmers. Partial success apparently assured by recent experience.

A small tractor starting out from a state fair ground to give a plowing demonstration

From the foregoing it will be seen that the widely successful light tractor has hardly arrived though it may be almost here. Changing conditions—higher horse and labor costs, greater familiarity with the gas-engine on the farmer's part, a growing inclination to plow deep and farm more scientifically—these, rather than mechanical improvements, favor the light tractor of to-day as against very similar machines of five years ago.

The light tractor problem is difficult. From the profit-and-loss standpoint, it costs more in proportion to build and to

Above, an 8-16 horsepower tractor plowing under a heavy growth of sunflowers

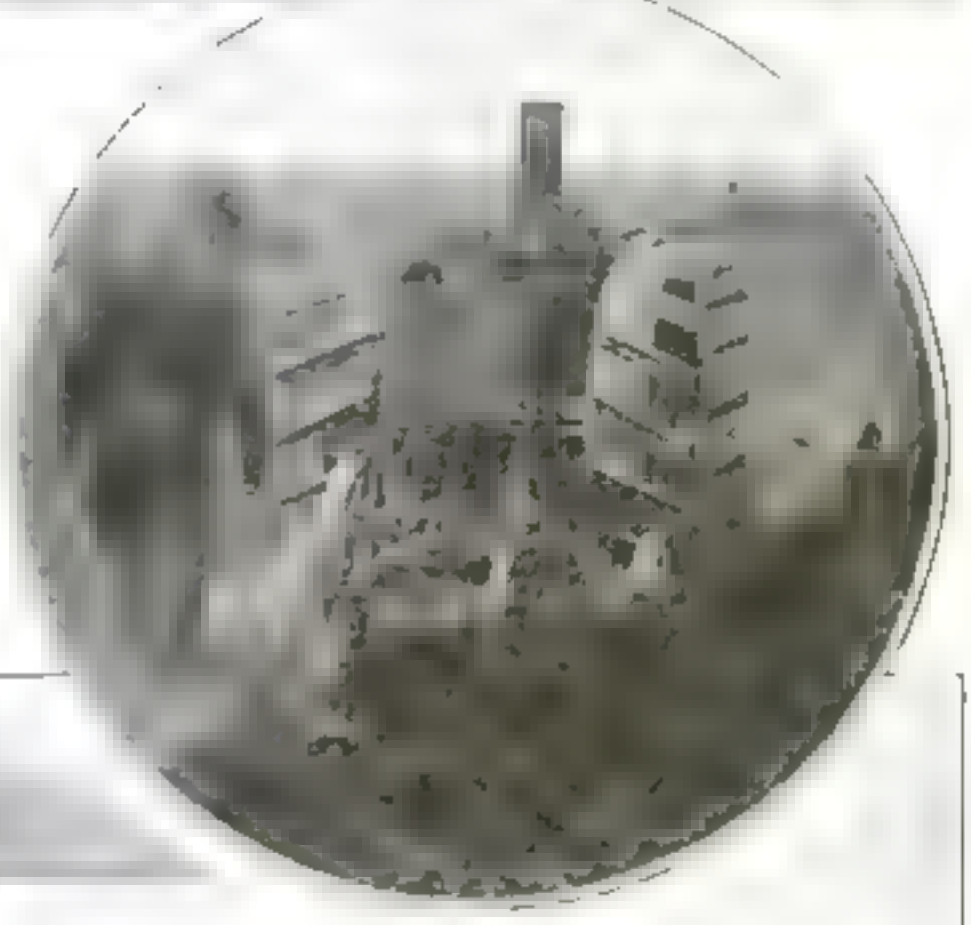
To the left, an illustration which shows that the possible width of furrow cut is much less in proportion to the width of a small round wheel tractor than in the larger outfit. The plow must travel at or near the right hand side of the tractor or else the tractor must move partially upon the plowed ground, with a loss of tractive power and the undoing of part of the plow's work

Below, a tractor plowing with one drive wheel in the furrow. The front wheel in the furrow helps to steer

Above is an 8-16 horsepower tractor plowing sod. Note the self steering attachment in front

To the right, a small tractor which is self steering and which has a light-draft two-bottom plow

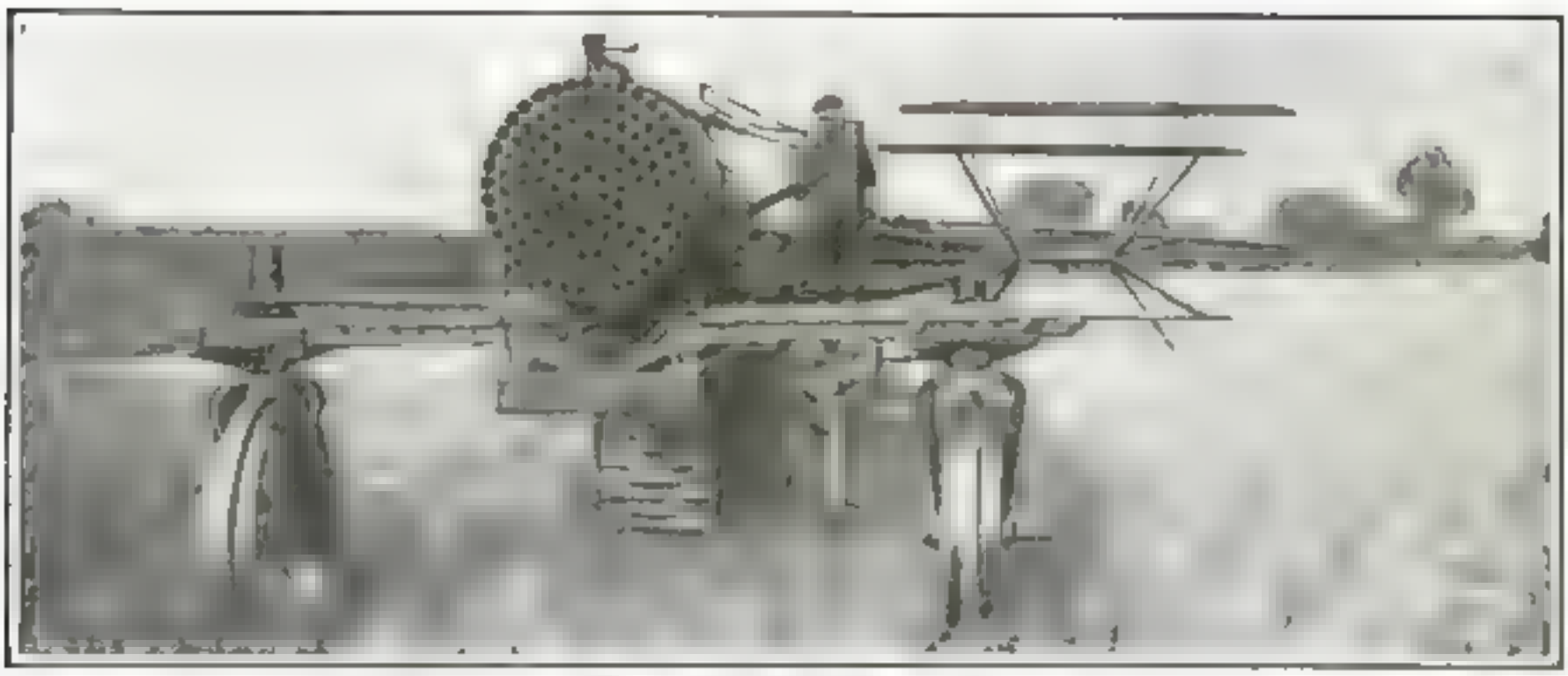
Below, a self-contained motor plow of the latest type, cutting three furrows at once. This illustrates one of the great advantages of the tractor, for it can really do multiple work, day after day, and with absolute reliability. Nothing but the worst sort of weather can stop it or delay its work



A tractor known to farmers as the steel mule

A well-enclosed type of small tractor

A single-drive-wheel tractor, with power lighting device for plows



The steel mule pulling a binder during the harvesting season

"Listing," a type of plowing common in the southwest. A drum-drive tractor is used

Two harrowings at once with an 8-16 horsepower tractor

Harvesting in North Dakota with a Ford car for motive power

Orchard plowing with a small caterpillar tractor. For such work the machine must be very low so that it can crawl under trees easily. This type of tractor can obtain an enormous grip on the soil because of the unusual length and breadth of its track or contact service

A small tractor running a big corn sheller When a tractor is not engaged in field work, it can be otherwise employed usefully

A small tractor pulling two binders while harvesting oats

The designer of this machine describes it as a "four-to-five 'horse-pull' sieve-grip" machine. It is here shown with tandem disks. The peculiar wheel construction is intended to secure traction; in fact, its traction efficiency is very high in proportion [to the weight and motor power

The use of the small tractor for threshing in the field has come into wide use in the West owing to its manifold advantages over the old method

operate; probably much less to sell. It displaces a smaller percentage of the farm's total animal power, which cannot be wholly dispensed with.

The smaller units of machinery which it operates are apt to present a higher cost per unit of work. Its earning capacity in custom work off the farm is less. It appeals more as a convenience, but the ability to rush work at the proper time on the farm is often really justified by a greater net return, regardless of cost.

From a mechanical standpoint, the difficulties are perhaps even greater. The small tractor is called upon for a greater variety of work than its large counterpart—light hauling, cultivation, and other jobs formerly done only by horses. It must, of course, run stationary machines and thus take the place of some of the larger stationary and medium-sized portable engines. It must do its field work over unfavorable grades and surfaces such as do not usually confront the automobile and motor-truck.

In plowing, the possible width of furrow cut is much less in proportion to the width of a small round-wheel tractor than in the larger outfits, and this has presented extraordinary difficulties in the way of side draft, hard steering and unequal wear. The plow must travel at or near the right-hand side of the tractor, or else the tractor must move partially upon the plowed ground, with a loss of tractive power and the undoing of part of the plow's work.

This problem of hitching, probably more than any other, is responsible for the failure of the small-wheel tractor to follow at once the lines of the large units, which are now practically all of the four-wheel type, with the two driving-wheels at the rear. The small tractors which do follow this conservative type are probably further advanced at present than the many radical variations from it, though this may prove to be due less to the principle than to greater experience on the part of the manufacturers.

Some of these variations are meeting with considerable success, especially that group which employs but one driving-wheel, mounted at the right-hand side so as to place the power directly ahead of the plows. An idler wheel on the left merely serves to distribute the weight of the machine and give the necessary stability.

Several small tractors dispense with the third and fourth wheels, carrying the entire weight upon two drivers. The hitch is made directly to the plow, cultivator or wagon, which completes what is virtually a self-contained outfit.

Other tractors, both three and four-wheel, are made self-contained by hanging the plows from the frame, usually underneath. The plows may be removed and the tractor used for pulling other implements. This type is at a disadvantage in soft ground, however, in that in case of miring down, the plows form an anchor from which it is difficult to cut loose.

A small tractor loading a silo

Soil conditions are far from uniform, and the plowing tractor cannot depend upon momentum to help it through the hard spots and up short grades. For this reason, very largely, the tendency seems to be toward the use of the more flexible four-cylinder motor. For the same reason, and the low coefficient of friction between a wheel and the soil, such extreme lightness of weight has never been found practical in the tractor as it has in the motor-car.

The average soil resistance to the plow in well-tilled loam, is close to five pounds per square inch of cross-section of the furrow slice. A furrow fourteen inches wide and seven inches deep will therefore require a pull of five hundred pounds, varying of course, with the type of

Bring the fresh air to your pillow, and avoid danger and the annoyance of getting up in the cold to close the window in the morning

soil and its physical condition. A two-plow tractor, therefore, should have an effective drawbar pull of one thousand to one thousand two hundred pounds, regardless of the speed at which it travels.

As the effective pull of a round-wheel tractor is seldom over one-fourth to one-third its total weight, it is hardly feasible to build the conventional tractor with much less than two tons of weight. In present quantities, well-built tractors of this size can seldom be sold for less than fifteen to twenty cents per pound.

The problem of the light tractor designer has, therefore, been complicated by factors of cost and mechanical efficiency which have made progress very slow.

Besides the wheel-type of tractor there is another class using either one or two endless steel belts. The "caterpillar" type, so-called from the trade name of a leading example, has peculiar advantages in the small-unit field in that it can be built narrow, with a low center of gravity, and still obtain an enormous grip upon the soil owing to the length and breadth of its track in contact with the ground. Very successful small tractors of this type are in common use, and the earlier disadvantage of extreme wear on the tracks has apparently been overcome by the use of good material and ingenious construction. The tractive efficiency is high in proportion to weight and motor power, steering is easily accomplished, and on either soft or hard ground the broad surface of the track has obvious advantages.

Still another type, as yet of little commercial importance, discards the plow and uses instead a rotary cylinder, studded with flexible steel hooks to pulverize the soil. An ordinary tractor chassis of light weight is used, the cylinder requiring practically no assistance from the drive-wheels in its forward motion. In fact, tests have sometimes shown that the cylinder helps to propel the entire machine.

A Fresh-Air Funnel for Your Bedroom

THOSE who are too timorous to brave a widely opened window in the bedroom may have their supply of fresh air brought to them without exposure by the window-fitting illustrated.

The device is in reality a fresh-air tunnel made of light fabric and held in place by hoops of metal to insure an open air passage at all times when the air-chute is in use. At one end the chute opens through a window-board, thus admitting the fresh air. The other end is draped over the head of the bed.

The air-chute may be opened or closed by means of a string.

An Automobile Dressing-Room for a Motion Picture Actress

MISS BESSIE EYTON, a popular motion picture star now stationed in Los Angeles, objected to going about in the costumes she had to wear while being filmed. She devised a way to turn her automobile into a dressing-room.

A small automobile was converted into a dressing-room, with pipes for heat and hot water It is now used as a dressing-room by a motion picture actress

Her wheeled dressing-room is a triumph of ingenuity over space. She has taken her small car and so carefully calculated every inch of volume that she has made a commodious dressing-room out of it. She has a place to make-up and a place for the costumes that will be needed during one day's work. The dressing-room is curtained, so that it is as private as the dressing-room of any theater.

But best of all she can have hot water and heat. A pipe with a drum and plate is connected with the exhaust-pipe, which runs through the car. Whenever she wants hot water or heat she has only to turn a valve and start the engine. This throws the exhaust through the drum, and in less than a minute the car is warm

Did You Know That Flour Explodes?

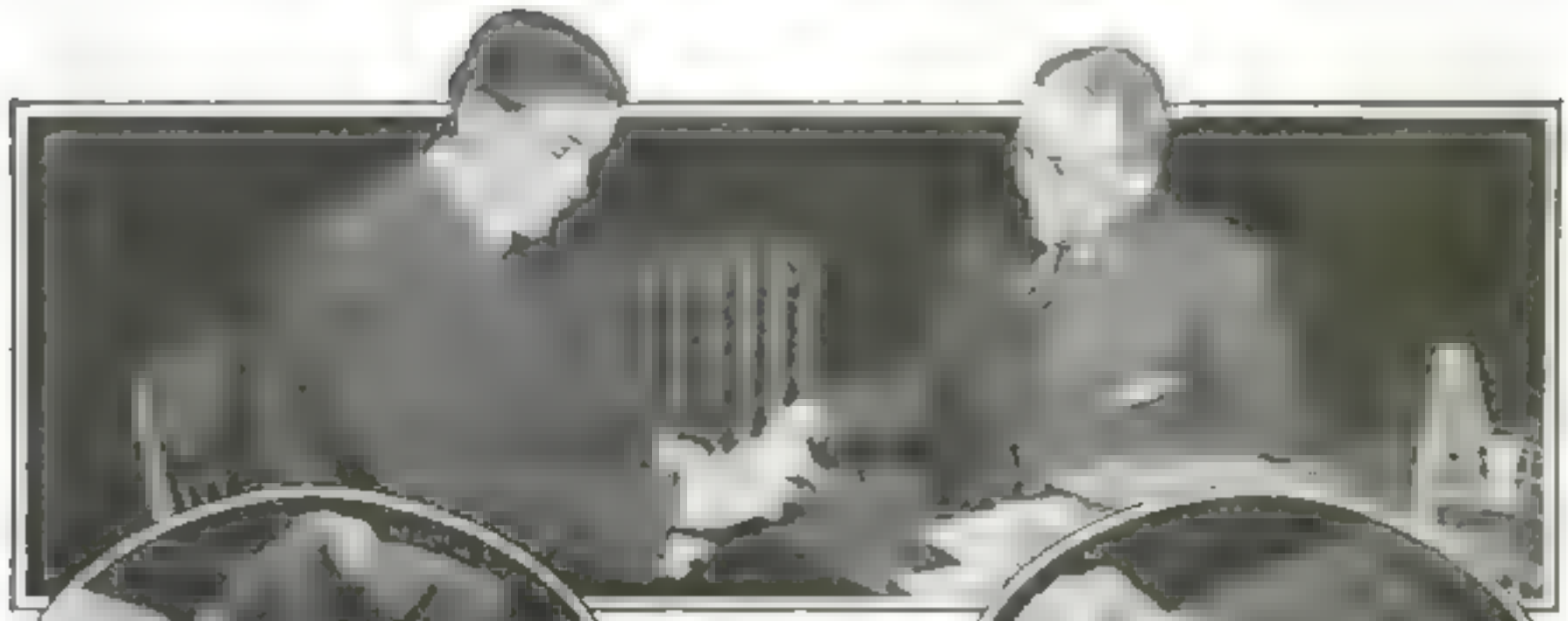
DURING the last ten years, about twenty explosions have occurred in cereal, flour and feed mills, with the loss of two million dollars' worth of property, as well as the killing or injuring of over two hundred employees. Investigations regarding the causes of these explosions and subsequent fires have not proved conclusively what are the difficulties to be avoided. In eight cases, the explosions are believed to have originated from the sparks produced in the machines during the grinding process. Tiny particles of gravel or metallic substances coming into contact with the plates of the machine may produce enough sparks to ignite the dust within the machine.

Another possible cause for cereal dust explosions suggested is the use of naked flames.

Sea-Scouts as Lamp-Lighters

WHEN the men of a country have to go to war, their responsibilities must be assumed by the women and children. The sea-scouts of England are boys who came promptly forward with their services in any capacity which might be required. In the illustration may be observed a sea-scout performing the useful task of lighting the street-lamps. Equipped with a bicycle and lamp-lighter, he makes his circuit in short time and does it as well, we dare say, as any full-grown man.

England is using some of her boy sea scouts to light street lanterns



These blocks differ in weight and should be arranged the heaviest first and so on down to the lightest

Prisoner doing one of the Bisch Simon tests This one consists of placing blocks in a frame, something similar to a jig-saw puzzle A normal person finds it surprisingly easy, a defective makes an hour's work of it

If the blocks are placed properly they make a man's head. The prisoner is putting the nose where the eye belongs

Science and the Criminal

By Louis E. Bisch, M. D., Ph. D.

The author of this article is one of New York's foremost psychiatrists. He is an associate in educational psychology at Columbia University and director of the Speyer School for Atypical Children in New York. To him we owe New York's interesting experiment of studying the criminal as a human being rather than regarding him as a destroyer of property and life. The new psychopathic laboratory of New York's Police Department has been placed in his charge —Editor.

IF a seven-year-old child were sentenced to serve a term in Sing Sing, a storm of protest would arise which would reverberate through the country. Yet, in effect, this is what is done. Criminals whose mentality measures only that of a seven-year-old child are made to serve jail terms.

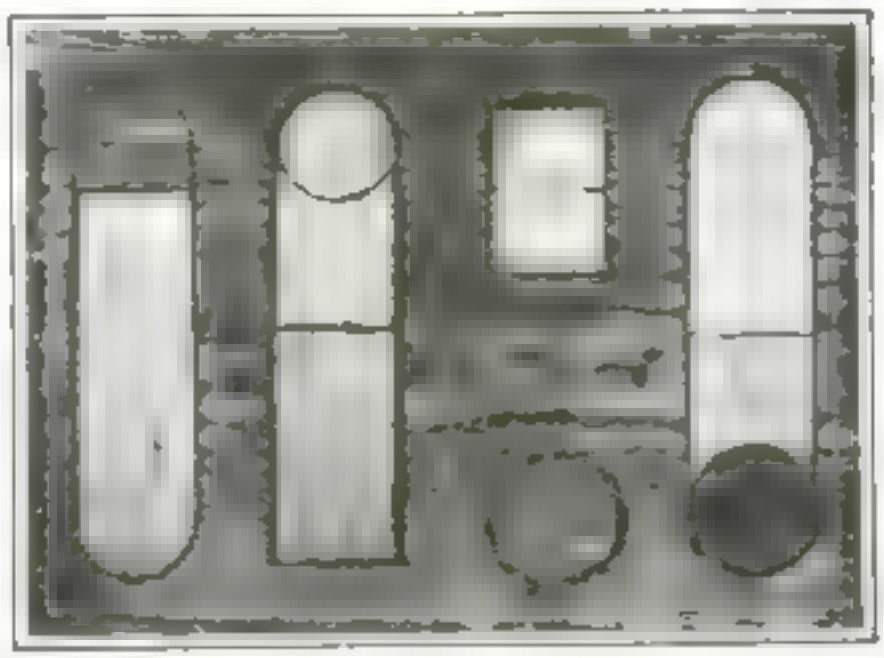
When a normal man commits a crime and is punished for it, the punishment is correctional. When a person of defective mentality commits a crime and is punished for it as if he were normal, the effect is to aggravate his tendencies rather than to correct them.

The primary object of our penal institutions is reformatory. A man of average intelligence, with a normal mind, may be led to see the error of his ways and to mend them through our penal measures. But the man who commits crime because of undeveloped or defective mentality cannot be benefited through any such means. A person who suffers from a mental defect which is curable should be not in prison, but in a hospital. And if his mental troubles are not amenable to treatment, he should be placed in an institution wherein his presence would be permanent, not temporary, and where his criminal tendencies would nor react against society.

Feeble-minded persons are not benefited in any manner through the serving

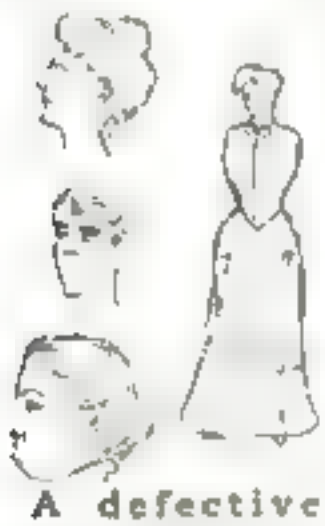
of a prison sentence. When they are discharged they are likely to repeat the offense at the earliest possible moment, and society is compelled to foot the bills for their frequent trials and commitments.

When Police Commissioner Woods became satisfied that a percentage of criminals should be dealt with as psychopathic patients rather than as normal men who have chosen to commit crime, he determined to test this idea. So it was that after a certain amount of experimental observation the Psychopathic Laboratory at Police Headquarters came into being.



The blocks must be placed in their proper openings—easy for you, but difficult for a defective

Before the laboratory was finally established we devoted forty-nine days to observations. Each day the prisoners at headquarters are "lined up" so that the detectives may recognize any familiar faces. At these daily "line-ups" we picked out men who appeared to be suffering from some mental defect and gave them a thorough mental and physical examination.

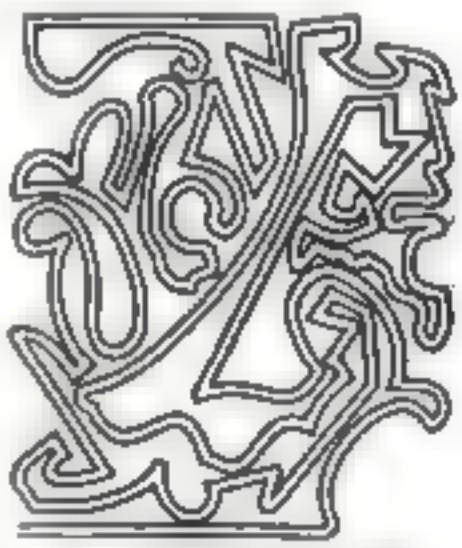


A defective takes time to puzzle out what is missing

During this experimental period, four hundred and nine prisoners were observed. Of this number, fourteen were found to be feebleminded, one insane, two constitutional inferiors, two drug habitues, one hopelessly immoral, one an alcoholic. Only eight were normal. Out of the twenty-nine selected for examination, twenty-one were found to be defective mentally. Seven per cent of those appearing at the line-up were examined and five per cent were found to be abnormal.

The average number of daily arrests during the period of our preliminary observation was six hundred and twenty-three and the total number of arrests was thirty thousand, five hundred and thirty. We feel assured that observations extending over forty-nine days are sufficiently comprehensive to warrant us in assuming that what we found indicates a condition which exists the year around. And as six hundred and twenty-three is the average number of arrests which take place every day and five per cent of those arrested are abnormal, thirty-one persons who are unbalanced mentally are locked up every day. These prisoners suffer from all sorts of mental ills ranging from dangerous forms of insanity to the pitiful condition of a grown man with the brain development of a child.

Criminals of this type cannot be improved through the ordinary corrective methods. They serve their sentences and return to society only to repeat the offense and pass again through the Police Department, the courts, the District-Attorney's offices back to prison from which they emerge each time more dangerous. This means that they not only constitute a constant menace to society but are a needless expense as well. Their constant reappearance in the courts soon mounts up to a very considerable sum. Also, it goes without saying, prison treatment is far from humane in the case of such persons. Where their difficulty is one which may be cured, they require hospital treatment and where it is incurable they should be committed to an institution wherein they would be protected



A defective finds it difficult to trace the course of this maze with a pencil

against themselves and removed forever from society.

At the conclusion of our experiments, the need for a sure method of detecting the mentally defective among the city's criminals became apparent and so after many conferences with the Department of Correction, Professor Edward L. Thorndike of Columbia University, Chief Justice McAdoo and a number of other magistrates, Police Commissioner Woods brought the Psychopathic Laboratory into being.

Before taking up my duties in the Laboratory, Inspector Faurot and I went to Chicago, where we studied the methods employed in the psychopathic laboratories there. Beside myself we have an expert psychologist, Dr. E. C. Rowe, who works in the laboratory every day. On our advisory board we have Edward L. Thorndike, Professor of Educational Psychology at Columbia, Dr. Frederick Tilney, Professor of Nervous and Mental Diseases at the College of Physicians and Surgeons, Dr. August Hoch, Director of Psychiatric Institute, New York State Hospitals, Dr. Woods Hutchinson, Arthur Train and Raymond D. Fosdick.

We have not confined ourselves to the use of any one particular test or scale for measuring mental ability, but have adapted to our particular needs certain parts of a number of well-known tests.

Every patient receives a thorough psychological, neurological and physical examination. If his case presents any peculiar problems we place it before our advisory board for special study.

Each day we receive a number of unusually interesting cases. I will cite a few at random.

Inspector Faurot turning over a case to the psychologist at the psychopathic laboratory at police headquarters. The inspector, at the right, is handing the history of the case to the psychologist

A physician making an examination of a prisoner at the psychopathic laboratory

A criminal who, because of his intelligence and the number and variety of his exploits, might have been a stage crook was brought in for examination. On the way to the laboratory he told the detective who had him in charge that the scrub woman who was working in the hall when they passed, knew him by name. He believed that the children in the street recognized him and was sure that all Italians did. When examined, this man showed a very high intelligence, but he was suffering from a form of insanity which might, at any moment, take a homicidal turn. From the nature of his calling it will be seen that this man was fearless, yet his insanity had taken the form of abject fear of recognition. His case was incurable. Obviously, prison was not the place for him

A fugitive from justice was arrested. He had served two terms before, one for assault and one for abduction. Examination showed him to be a high-grade imbecile, his mental age being seven years. This condition is incurable and it is certain that each time such a person gets out of prison he will commit another crime. His ability to reason and his range of ideas were both exceedingly limited.

A waiter was arrested charged with attempted blackmail. He had sent a threatening letter to a company demanding $500,000. When examined, he was perfectly willing to talk about his efforts to obtain the money and believed it was due him. He was found to be insane and the only proper treatment for this difficulty is that which he would receive in an insane asylum.

The most revolting and hideous crimes are those committed by mental defectives. These persons possess an unusual amount of cunning, which makes their apprehension difficult. It is generally

A tree which braided itself into a rope

believed that many of the terrible crimes which have never been solved have been committed by defectives. It is impossible to know just how frequently and to what extent feeble-mindedness exists. It is the purpose of the laboratory to accumulate statistics concerning criminals who are definitely abnormal so that material will be at hand which may be used in the great struggle towards the prevention of crime.

A Braided Tree

NEAR Arlington, Ohio, is a small tree which departed radically from the way a well-behaved tree should grow. Two inches above the ground, this tree divides into three parts, which twist around one another in the curious manner shown in the illustration. At the height of five feet the three parts diverge like the branches of an ordinary tree. Note in the background a similar tree, but having only two parts.

An Adjustable Crutch

THE military hospitals in Germany have a crutch that fits every one. Extended, it will accommodate an eight-foot giant; or it can be shortened to fit a midget. It can be taken apart and used as a cane by the convalescent.

During the recent exchange of prisoners a wounded Canadian was allowed to bring his adjustable crutches with him, although it is the custom to fit every patient with an artificial limb or regulation crutches when he leaves. Adjustable crutches are considered part of the permanent emergency equipment of the hospital. Many other appliances, such as artificial limbs and hands, which can be used for many necessary operations, are being perfected for those crippled in war.

The Germans made these adjustable crutches to be used by long and short men

Shelter-Top for London's 'Bus Riders

LONDON rains and London fogs will before long have no terrors for that portion of the populace that prefers to ride atop 'busses in order to gain the benefits from the outdoor air. Weatherproof coverings or tops are being installed on all of London's 'busses, and their construction is such that they can be put up or taken down in two minutes.

In the photograph, which shows the new rain-proof 'bus-top, can incidentally be seen rows upon rows of posters, one way of advertising which the British army is employing. Evidently proceeding along the theory that repetition is the best way to advertise for anything, the same poster is used over and over again, in the hope of driving home a lesson to the reluctant Briton

Londoners no longer have to ride on their beloved 'bus-tops in the rain. Here is one of several designs of detachable tops now being installed

Better Than the Bread Mother Baked

THAT civilized person to whom has never come the pleasure of tasting bread as it is baked in the open—that is, baked in a shallow clay oven, fired by charcoal, as the bread of our southwestern Indians, the bread of the Bolivian Incas, and the Argentine cholos, is baked—has never really tasted bread as it was intended to taste. It is a little coarser, perhaps, than the snow-white bakers' bread of the large cities, but it has nourishment and flavor that are unmatched.

The brick ovens of our ancestors baked good bread. The bread from the clay ovens of Bolivia is said to be even more nourishing and delicious

In South America the oven is very simple in structure, consisting merely of a hollowed-out clay or mud mound, sometimes supported on a wooden framework, as is illustrated here, but usually by a rock pile.

Repair for Cracked Window

A WINDOW that is cracked can be repaired temporarily by bolting two roofing nail-caps where the cracks meet. Roofing nail-caps are large tin washers with small holes which must be reamed out to accommodate a machine screw.

A Detachable Motor for Bicycles

A SMALL motor, developing one horsepower, which may be quickly clamped to the frame of any standard bicycle has been placed on the market The entire motor, including magneto muffler and carburetor weighs but fifteen pounds, and the fully equipped motor-bicycle may be picked up and readily carried to any desired resting place

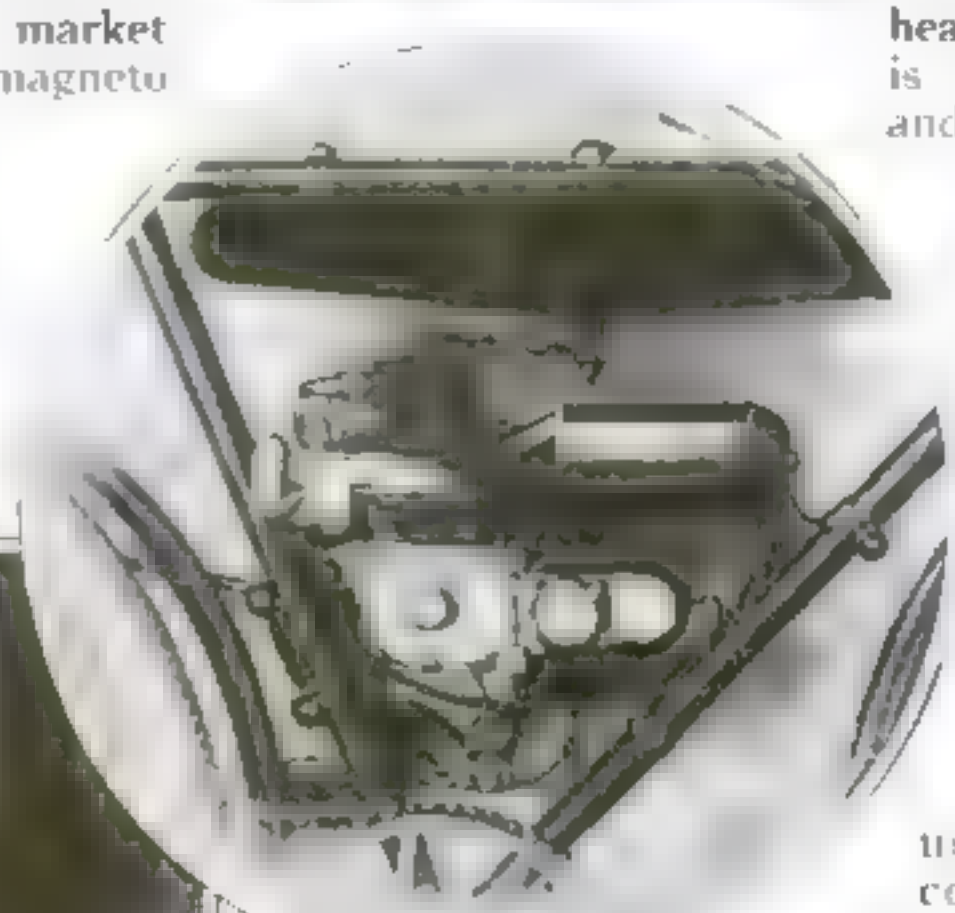
The motor is said to be capable of propelling the bicycle

An American manufacturer makes a motor which is so light that the whole machine can be picked up and carried as easily as a standard bicycle

and rider from two to twenty-five miles an hour. It is of the two-cycle or two-stroke type, which gives an explosion at every revolution of the crank-shaft, resulting in a marked absence of vibration The speed of the engine is controlled entirely from one lever on the handlebar which advances and retards the spark

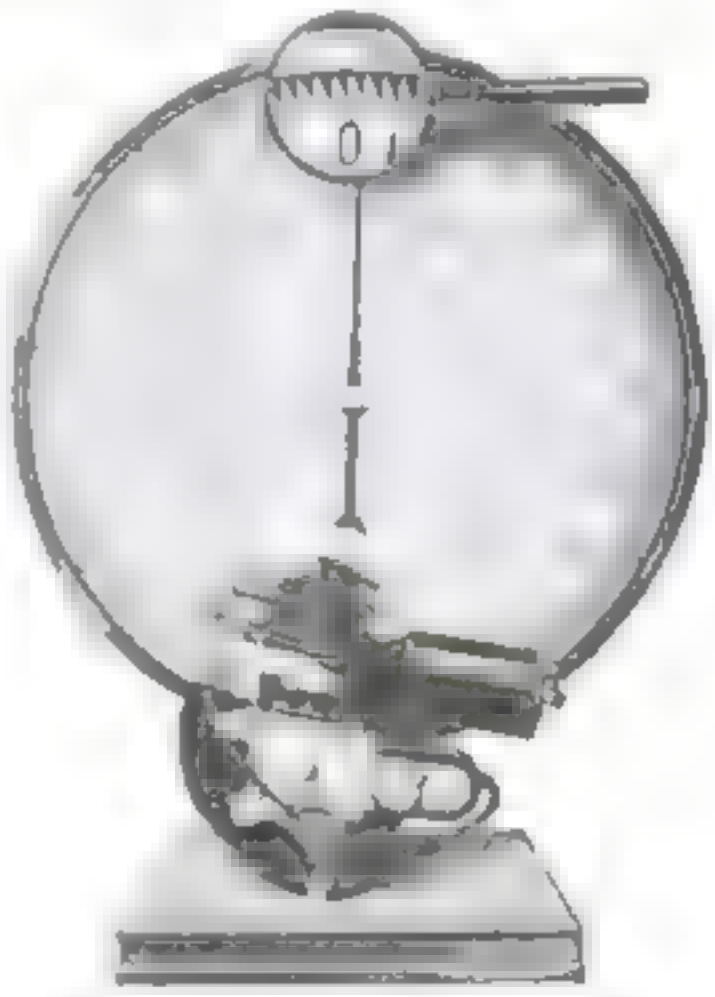
Soda Pulp Has Many Uses

THE uses of soda pulp have been greatly expanded during the course of the war. Resembling cotton in softness, strength and lightness, it is being used in the manufacture of explosives and articles of clothing which have hitherto demanded the use of cotton. For centuries, Scandinavian countries have lined the walls of their homes with soda pulp. It is a poor conductor of heat and therefore reduces the cost of heating; it is airtight and therefore keeps out the wind and cold In Germany soda pulp is now being used as covering material for wooden barracks



The motor is hardly more cumbersome than the flat boxes that fit inside the bicycle frame to carry clothes on cycling tours

Cellulose wrapping paper is being made from soda pulp, since its durability and strength have been shown to be very great. It may also be used for foot wrappings for soldiers



The whole motor weighs only eleven pounds, ready to attach

Pouring oil on the troubled waters is no longer a marine necessity, if bubbles of air are handy. Inventors have been experimenting for years on a scheme for stopping breakers by means of compressed air

Breaking Storm Billows With Compressed Air

THE gnawing seas are ceaselessly busy changing our coast lines. The bulk of us are unaware of this, but the coast dweller, particularly he who lives near sandy beaches, can tell many a story of wind-lashed breakers and pounding surf. Whole stretches of the New Jersey coast have been undermined and demolished in this fashion Our sandy western shores have been similarly assailed, and property owners on both seaboards have spent great sums in trying to rear barriers against these attacks. Unhappily, neither bulkhead nor jetty has proved permanently effective, and the fundamental reason of their failure lies in the fact that they are designed to halt the well-nigh irresistible onrush of the storm-tossed billows.

A test will shortly be made upon the southern coast of California of an ingenious system which represents a minimum of cost compared with what it is promised to do. It is not essentially an experiment, because the principles involved have been tried out before, with encouraging results. The lay mind instinctively pictures a rigid bulwark of some sort, for nothing short of this seems logically the medium to arrest the mighty drive of a great tumbling wave. And yet Mr. Philip Brasher, the inventor, employs nothing more substantial than a curtain of ascending air bubbles!

The feasibility of the scheme hinges upon two factors—a knowledge of wave motion and the catching of a billow before it has time to break. Despite what most of us think to the contrary, the body of a deep-water wave does not ma-

terially advance, but the vibratory impulse that creates the wave does move forward. We have an every-day illustration of this in the fluttering motions of a flag. But there comes a time in this disturbance, where water is concerned, when the mass affected does actually advance. This is when the body of the wave can not rise and fall without losing its balance, so that it tumbles over, breaks, and goes pounding up the incline of the beach and hurls its volume violently against anything standing in the way. The shallowness of the water is responsible for this, because there is not room for the abnormal vertical movement set up by the wave-making impulse with its onward drive.

Now, as Mr. Brasher reasons, if the wave-forming action of any particular body of water could be upset, then the creation of the billow would be nipped at its very beginning, and there would not be a chance for the development of that movement which would be capable of acquiring destructive momentum. It is like checking a flywheel at the start instead of trying to bring it to a standstill after it has attained some speed of revolution. To this end, the Brasher system has recourse to an air compressor connected with perforated pipes laid on the sea-bed, far out in the water, and deep enough to sustain waves before they become breakers—in other words, before their staggering masses tumble violently forward. In rising, the air bubbles tend to interrupt or to destroy the rotary motion of the water particles—that movement which is characteristic of the wave. By doing this the wave impulse is checked, and the billow subsides and passes shoreward into shallow water, effectually robbed of its power to do harm. This disruptive effect of the bubbles is magnified by employing compressed air, because the globules expand as they mount and increase their interference as they get nearer the surface where the lashing crest of a wave has its birth.

But the Brasher air-breakwater is not designed merely to safeguard beaches. It might be adapted for the temporary calming of the waters about a stranded ship so that her salvage might be undertaken at any time. An installation of this sort was made on the rocky coast of Massachussetts where a wharf could not be built in a sheltered haven. The air, supplied from a compressor, made it possible to load barges with stone at all times instead of waiting for favorable weather. It is easy to imagine other applications, for instance, such as the building of piers and the like which normally would be halted if the wind-swept waters were seriously disturbed.

This is a smoke laundry. After having been washed the smoke is enriched by oil and gases and is conducted again into the stove where it is thoroughly consumed

Laundering Smoke and Using it Over Again

FOR the purpose of abolishing the smoke given off by a coal stove and of employing the unconsumed gas and particles of carbon which ordinarily go up the chimney and are wasted, an arrangement of pipes and water tanks has been devised. The apparatus consists of three tanks connected together and to the top and bottom of the stove. Smoke leaving the stove is conducted first to a cooling tank composed of a coil of pipe submerged in cold water. From this coil the smoke is drawn by a suction pipe into a second tank filled with water. Here the smoke is thoroughly laundered, passing on into the third and last tank, which is partly filled with water and kerosene.

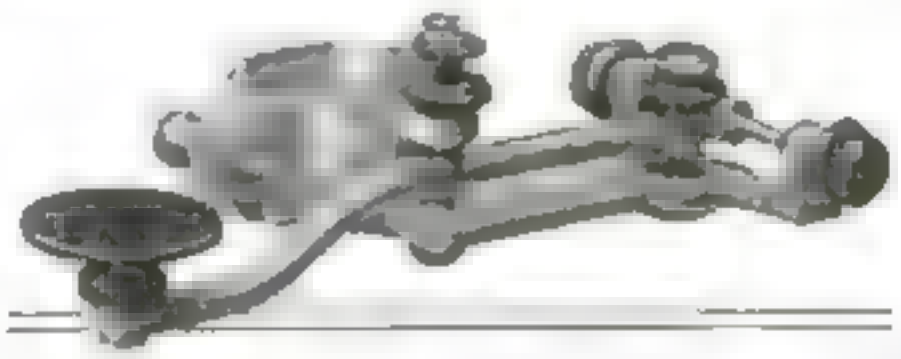
The laundered smoke is enriched by the oil and passes again into the stove, where it is thoroughly consumed. From the standpoint of health, this arrangement is highly desirable.

Telegraphing with the Telephone

THE man at the telephone is telegraphing. He is Paul P. Banholzer of Philadelphia, connected with the steam engineering and electrical department of the Navy. He has increased the efficiency of the telephone by devising a telegraph-transmitter which can be attached to any telephone standard. The connection between the two instruments is purely mechanical and not electrical. The device does not require an additional electric circuit. Its advantage lies chiefly in the fact that the Morse signals sent by this instrument carry farther over a long distance telephone line than the voice and that the sounds produced are definite and unmistakable even to an inexperienced person.

The instrument is especially useful in telephone train-dispatching. If the telephone conversation is not clearly understood it can be verified, or supplemented by the telephone-telegraph instrument.

A telegraph-key attached to a telephone, which places the whole vast telephone system of the country at the disposal of the telegrapher



The telegraph-key is mounted very much like any other telegraph-key, except that it is pivoted at its extreme end; the sound that it produces is sharper than that of the ordinary telegraph-key and is conducted to the telephone through the metal base and through clamps which encircle the telephone standard and fasten the instrument in place.

The apparatus is being tested out at the Philadelphia Navy Yard with wireless. It is claimed that if conversation can be transmitted by wireless telephoning, telegraphing by wireless telephone with this instrument, can be conducted by any "wire" operator, and that it will be possible to introduce wireless on all railroads. When telegraph wires are down, this device can be used on the telephone circuit in conduits underground.

Cane Holds Doctor's Medicines

AN eccentric physician, who did not like to be seen carrying a medicine-case, devised a hollow hard-rubber walking-stick with a sliding metal holder for the bottles of tablets and powders and other first-aids. This metal holder is a half-tube, slightly crimped at the edges, so as to grip the bottles tightly enough to prevent them from falling out when the tube is pulled out of the cane. To all appearances the cane is just like other walking-sticks, but when the old physician removes the handle, by unscrewing it from the straight part of the cane, a sort of button is revealed, which serves as a means of grasping and pulling out the tube with its drugs.

The doctor did not care to carry a medicine case, so he filled a hollow cane with pills instead

How a Boy Delivers Packages with His Own Bicycle-Trailer

A BICYCLE-TRAILER of effective design has been built by a Battle Creek boy to expedite his work. With the trailer he finds it easy to transport bundles and boxes and to finish his task in much less time than if he attempted to haul the bundles on a small express wagon, such as that commonly employed.

The inventors of automobile appliances are now giving much attention to trailers. This boy invented his own trailer for carrying packages with his bicycle

The trailer is simple in construction. A two-wheeled platform is fastened to the bicycle by means of a curved rod, which follows the contour of the rear wheel and which is bolted to the saddle fittings.

The metal rod obviates any possibility of a rear-end collision, while the pulling power of the bicycle is not impaired. The trailer does not impose an unusual burden on the rider, especially when the wheels of the trailer are kept well oiled.

A Pocket Safe

CONVERT a pocket flashlight into a purse by simply taking out the battery.

Why the Automobile "Goes Dead"

It frequently happens that an automobile, particularly the Ford car, will stop suddenly and all attempts to "make it go" will prove ineffective. Battery and all other parts of the ignition, the magneto and spark-plugs, seem to be in good condition and yet the car will not "spark." In this case the fault probably lies in the contact-brushes of the magneto. A small particle of dirt, getting under the contact-brush, will effectively stop the car. Examining the brushes in such a case will save much unnecessary work, and a trip to the garage.

The Refreshment Tree

AT Mount Lowe, California, the thirsty visitor has only to turn on a faucet projecting from a large tree near the hotel and water begins to flow. No waterpipes are to be seen and curiosity is aroused at once.

As a matter of fact, the lower part of the tree is hollow, and the pipes were run along underground between the roots and up through the hollow part to a knot hole, where a faucet was attached. Around the faucet the hole was plugged up with cement which looks like the tree itself. Drinking is popular here, perhaps because the visitors think it is the tree of knowledge.

To passers-by the tree is an inexhaustible supply of water. But the source of water is a pipe ingeniously concealed within the trunk of the tree

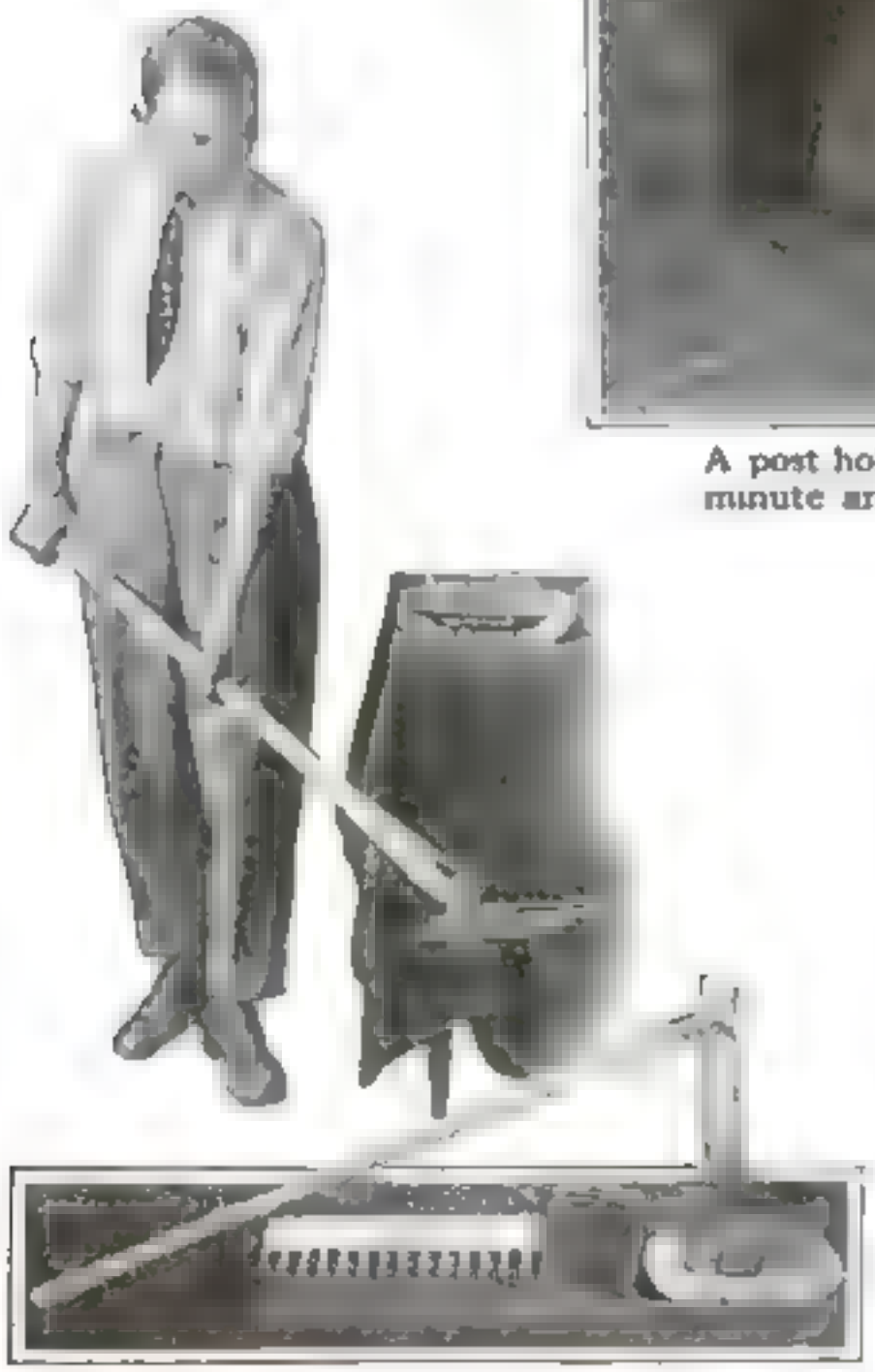
Ingenious Machines to Work for the Gardener and the Farmer

A Whole Garden Kit in One Tool

SEVERAL devices have recently been invented to make the task of creating your own garden agreeable.

A handy new implement capable of many uses has been invented by Joseph De Falco, of Vineland, New Jersey It may be quickly converted from a hoe into a rake, from a rake into a weeder and from a weeder into a shovel. It has a handle to which any of these tools may be adjustably clamped; besides they can be tilted at whatever angle is handiest. A pivotally-mounted, ridged headpiece and a fastening-guide arranged to engage the teeth, make such adjustments a matter of choice with the gardener.

A post hole digger of this type will make a hole in a minute and a half. It does the work of fifteen men



This garden tool is a hoe, a rake, a weeder or a shovel

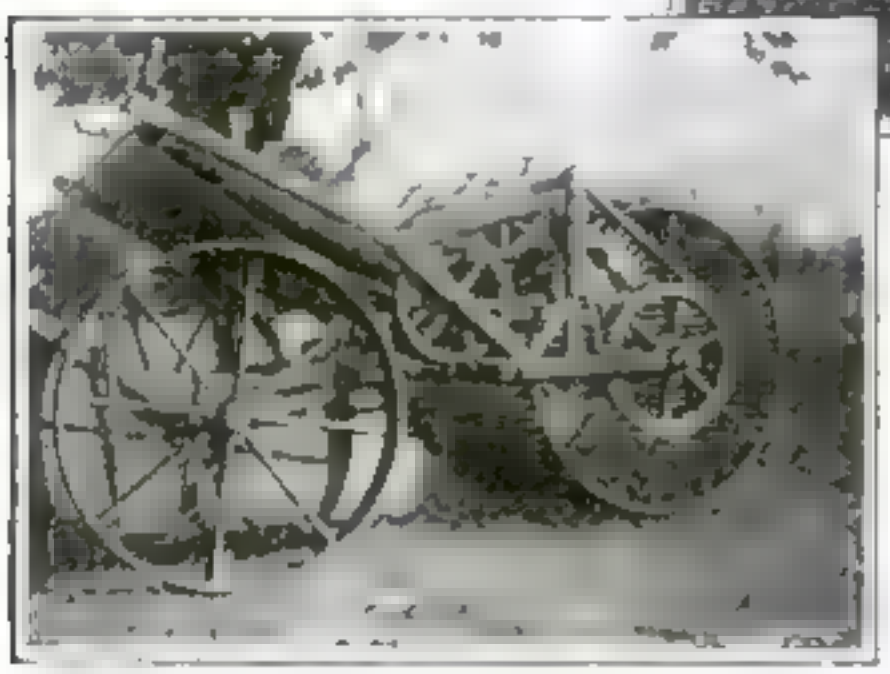
Digging Fence-Post Holes by Means of a New Machine

FOR the gardener and the farmer a hole-digging machine has been invented by August Enstrom of Rock Island, Ill. Up in New England, where the fertile hills are rocky, there are good farms with perfectly built, picturesque stone fences extending in all directions. Sometimes they have cost almost as much as the farm is worth. A hole-digging machine would have made it

easy to put in posts and have wire fences. The farmer could then have put his profits into the banks instead of his straight stone fences. The Enstrom hole-digging machine has a digging or cutting blade fitted on the lower end of a spindle which is driven by various gears from a gas engine

The machine also has an endless conveyor belt with spaces which are constantly carrying up the earth dug by the cutting blade and depositing it in a chute which throws it to one side of the machine. This belt, of course, is also operated by the power from the gas-engine

The machine is mounted on a truck which can be pulled around wherever the gardener or farmer wants to use it. In fact, the machine



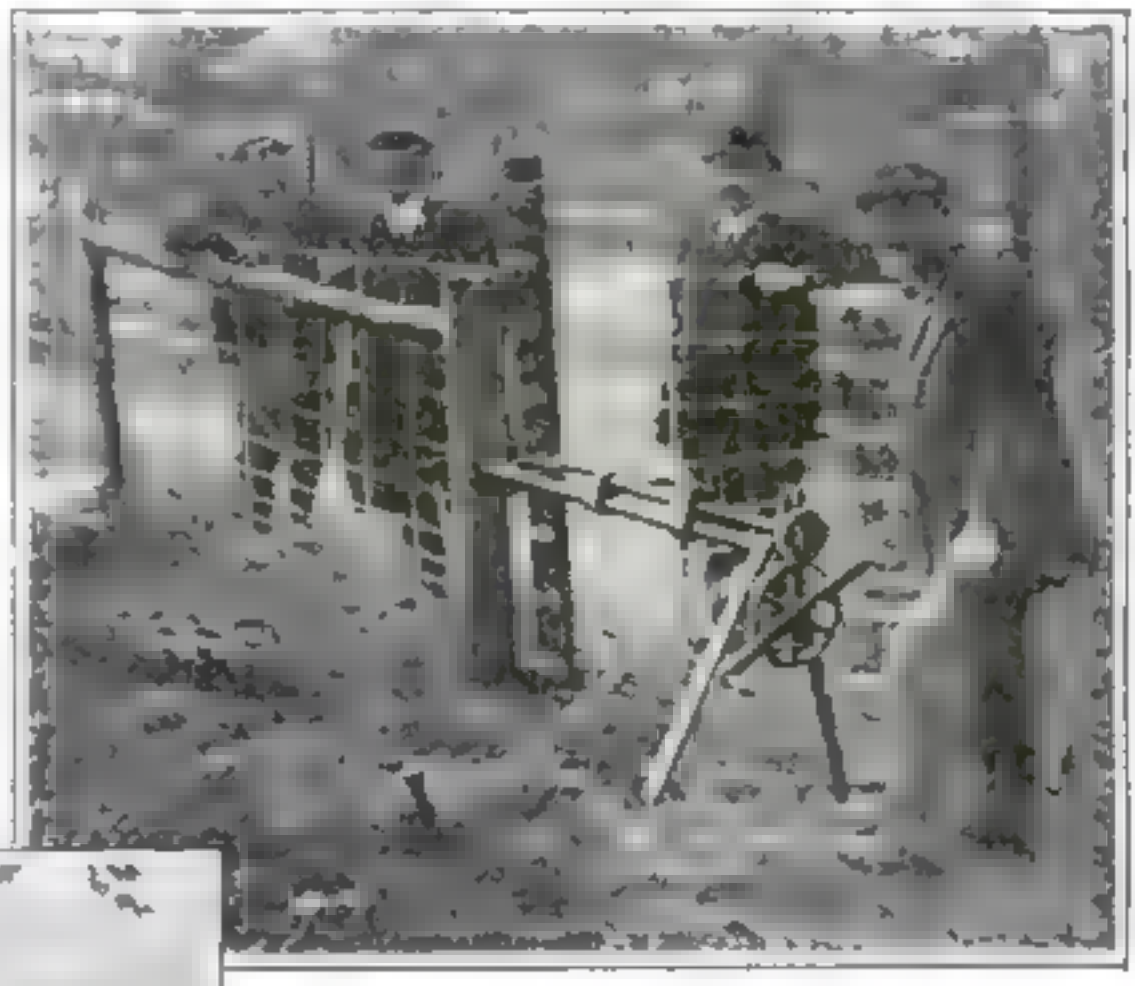
The newest fruit picker is a roller which lifts the fruit up from the ground after it has fallen from the tree

does the work of fifteen men. It digs a hole ten inches wide and over two feet deep in a minute and a half. When there are interfering obstructions it takes a trifle longer. The machine can be so adjusted as to make the hole any width desired.

Stretching the Wire Taut

WHEN the holes are dug and the fence posts put in, the next problem is stretching the wire for the fences. C. N. Edwards, of Hillsboro, Ohio, has devised a new wire-stretcher, which is light and portable. It can be readily set up and arranged for use wherever desired for constructing and repairing wire fences.

The various strands of the wire fence are held between a pair of bars which are clamped together on opposite sides of the



A new wire-stretcher which pulls the whole of a web fence by one hand-operated gear

fence-wires. A chain fastens these bars to the traveler-block of the wire-stretching machine. This traveler-block is screw-threaded and operated on a screw-shaft, which carries a small gear. These gears mesh with a large gear turned by a double crank in the hands of the farmer or gardener. The gears are supported by a two-legged frame which gets further support from a long guide rod which rests against the last fence post.

For Gathering Fallen Fruit

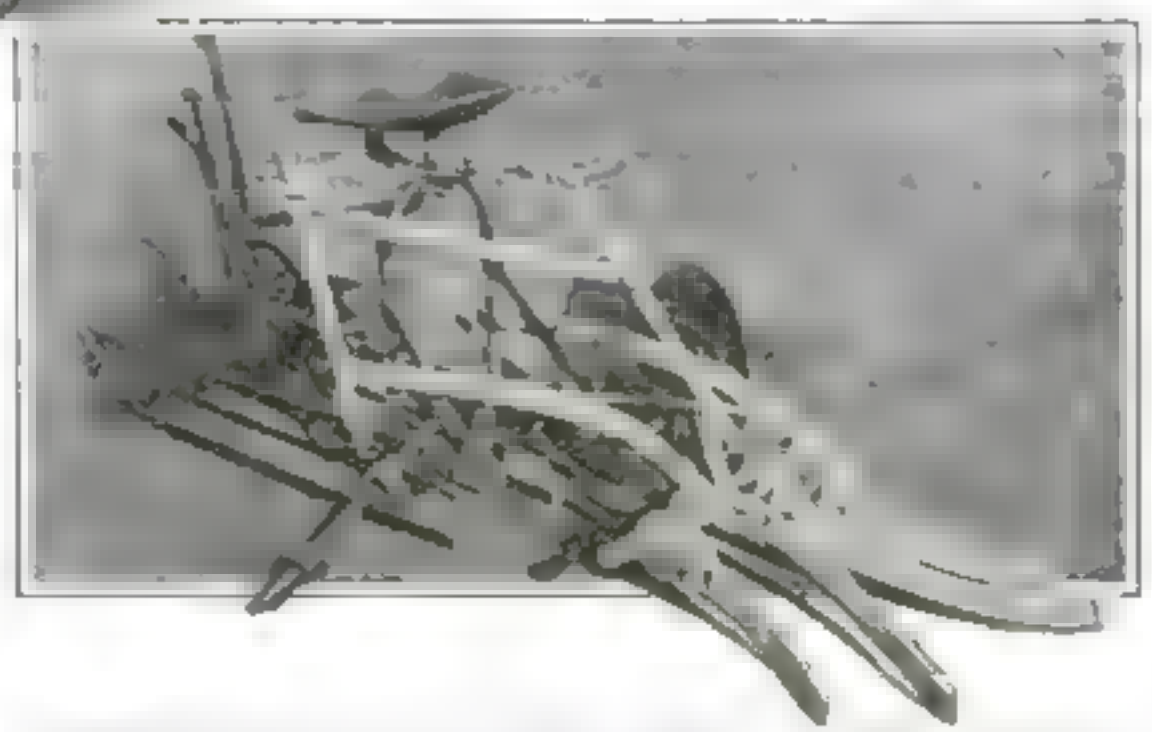
A CALIFORNIA fruit grower, Peter H. Lint of Los Gatos, has devised a machine for rapidly gathering up fruit which has fallen to the ground. A large roller with prongs projecting from it picks up the fruit and transfers it to the box carried by the rack. The machine is pushed along as if it were a huge lawn-mower. It is particularly useful in gathering fruit which has to be evaporated, such as prunes and apricots, and which will not be damaged by being pricked as a result of the novel method

of gathering. Many varieties of fruit ripen about the same time on the Pacific Coast and there the machine is especially valuable because the prune-grower is in danger of being left short-handed.

Taking the Bump out of the Barrow

A MAINE inventor, George S. Nichols of Freeport, has taken the jounce out of the loaded wheel-barrow by attaching the ends of the wheel-axle to springs which are fastened to the side bars of the barrow-frame instead of around the axles directly to the ends of the side bars—the usual method. This makes it easy to handle a loaded wheel-barrow. When the wheel bumps against a stone the springs take up the jar instead of the wheel-barrow passing the jolt along to the man behind.

A wheel-barrow with springs takes more kindly to uneven roads than the old-fashioned sort



If this disk-sled attachment is applied to an ordinary sled-harrow, cross harrowing can be done without a special implement

Making a Disk-Sled of a Harrow

CROSS-harrowing levels the ground, conserves the moisture and eliminates the furrows. A disk-sled attachment, invented by L. A. Gaume of Danville, Kan., can be readily fastened to any make of sled-harrow to do this work. The attachment has a spring pressure device by means of which the large wide ridge that is thrown up by the cutting-disk is divided into four small narrow ridges. The various harrow-knives level the ground, close up the furrows, lessen the work of harrowing, prevent evaporation of moisture from the land and reduce the danger of soil blowing. Any kind of soil may be worked with the attachment.

Effects of the War on German Industries

THE industrial situation in Germany has undergone many changes during the course of the war. A great insurance reserve for soldier workmen invalided in war was started so long as ten years ago, but the frightful struggle which is now in progress and its harvest of permanently disabled men were hardly expected. Soon after the war had started, however, the necessity for drastic measures became clear to the men prominent in the manufacturing industries, with the result that a method of developing and utilizing the productive capacity of crippled soldiers was instituted. In carrying out this work, the *Verein deutscher Ingenieure* provides prizes for methods and appliances which will enable disabled workmen to carry out the duties of normal men. Wherever possible, the veterans are returned to their former tasks. Often the problem of finding new employment for them must be solved.

The large iron, steel and machinery plants are caring for thousands of families, the heads of which were formerly employed in their shops. The expense to each concern averages over one hundred thousand dollars a year. It is a remarkable fact that the complicated systems of industrial insurance in existence have been able to make all payments demanded. Sick-benefit funds for the factory employees are already consumed.

A Sycamore Stump for a Lamp Post

IN a Pasadena, Cal., front yard stands an old sycamore stump about ten feet high. A foot or so from the top are the stubs of two branches. The owner of the property has conceived the idea of converting the stump into a lamp post. In the top and at the end of each branch stub he has placed an electric light bulb. These are connected with a source of current in his house by wires that run under the sidewalk and up through the trunk of the tree.

An old sycamore stump which was made both useful and decorative by the simple use of three electric lamps

Waste of sandpaper and of patience is eliminated by this efficient little block

Sandpapering Made Easy

SANDPAPERING has always been a disagreeable job because there has been no convenient device for holding the sandpaper. A sandpaper-gripper invented by Logan H. Fowler of Colony, Kansas, provides a means for holding the sandpaper without crumpling it and without exhausting the patience of the man who is attempting to put the final polish on a piece of furniture.

The sandpaper is stretched over the bottom of a block and fastened by gripping members at each end. The block has a handle which is readily grasped in the hand; thus a convenient tool is provided for the carpenter or the cabinet-maker. It saves time and requires only about one-sixth of the amount of sandpaper generally used.

A Method for Packing Barrels

A DEALER who had at different times a number of barrels to fill with a fine powder, wanted to get as much as possible into each barrel. He hit upon the scheme of placing two lag-screws (about a half-inch by three inches) under opposite edges of the barrel somewhere near the center. By rocking the barrel back and forth a few times it jolted the powder down until it was quite solid. This method can be successfully used for a great variety of articles. Lag-screws cost but little and they will last forever. The square heads keep them from rolling. The screws will fit any size barrel and can be carried in the pocket so they will be handy when needed.

Raising Goldfish by the Acre

Millions of goldfish are raised on this farm. More money can be made out of goldfish than out of grain

Photo from life by Dr. R. W. Shufeldt

Raising goldfish is no lazy man's job. You must wade in and sort out the marketable fish with your bare hands

INTENSIVE goldfish farming is more profitable than cattle-raising, in the opinion of Eugene Catte of Langdon, Kansas. He has ten acres of ponds given over to the raising of the shiny little parlor fish. Millions of goldfish have been reared by Catte since he started in the business years ago, but the demand for goldfish continues to grow.

That fish farming is a paying business when conducted on a wholesale scale is evidenced by the fact that this Kansas farmer has been able to make as much money from his ten acres of goldfish ponds as other farmers from their one hundred and sixty acre farms. In fact, the industry has grown to such proportions that Catte has turned his big grain farm over to his son in order that he himself may devote all of his time to the raising of goldfish.

Years ago Catte started a private fish hatchery on a homestead he had taken up near the foot of the sand hills. He was able to convert some bogs and a spring into a fish pond, where he began raising fish for the market. There soon sprang up such a demand for small fish, however, that Catte found it more paying to turn his attention to goldfish. Now his business has grown to such an extent that his hatchery covers thirteen acres and is composed of fifteen ponds, ten of which are devoted to goldfish.

Catte's busy season begins in the autumn. Most of his time is spent in wading about in high rubber boots, sorting out the marketable fish with his bare hands. This is no lazy man's job. Goldfish farming consists in something more than reading the newspaper on the back porch, waiting for the fish to grow.

Expense in Motion Picture Making

By Albert Marple

IT IS indeed difficult for one who is not on the "inside" of the motion picture business to realize the expense to which a picture company will go to secure effects necessary for the successful filming of a photoplay. Sometimes the setting for a single scene costs hundreds and even thousands of dollars. When it is considered that even a one-reel play consists, generally, of something like fifty scenes, it may be readily understood that the cost of producing even a single reel play is enormous. What, then, must be the outlay for five, six and even seven-reel plays? A few months ago the writer traveled with a company during the making of a one-reel play. It took the company four days to put the play on and, although not a single setting was made for this production, the work being mostly outside the studio, that "one-reeler" cost the company about nine hundred dollars. The joke of it was that after being made and finished, that particular play was "pigeon holed" and, for some mysterious reason, was never copied for circulation among the motion picture theaters. This is but one source of the "incidental" expense of a company.

Street scenes cost the most. It is indeed seldom that a scene of this character does not run up into the thousands of dollars. Weeks and months of work will be put upon a street for a single scene. Just as soon as that particular scene has been successfully "shot," down it comes and another "street" rises in its place.

A street scene built for the play, "Terrance O'Rourke" is an exact reproduction of a street in Tangiers, Northern Africa. Employees of the

It took nine tons of powder to make this explosion, the smoke from which clouded the air for two minutes in the resulting motion picture

This "Street Scene in Old London" looks ample, but it was only a little less expensive than transporting the entire theatrical company to London itself. In the circle, a "Master Key" mine scene, all of which was made to order with the exception of the mine dump and railroad on the hill The Western scenes are naturally less expensive than the reproduction of a European street, but their cost is rather more than would be expected

The Western mining town shown below was burnt at a cost of $1350

picture company combed libraries in search of information concerning Tangiers. After days of labor, assisted by librarians, they found a picture of a Tangiers street. From this photograph, artists constructed the scene. The buildings were made accurately to the scale of the photograph; the fixtures, the rugs hanging from the windows, the awnings, the palms on the roofs, the doorways, and in fact all details of the picture were painstakingly worked up into true dimensions after weeks. A citizen of Tangiers might have imagined himself at home if he had walked down that stage-street. This scene cost the producing company something like fifteen thousand dollars.

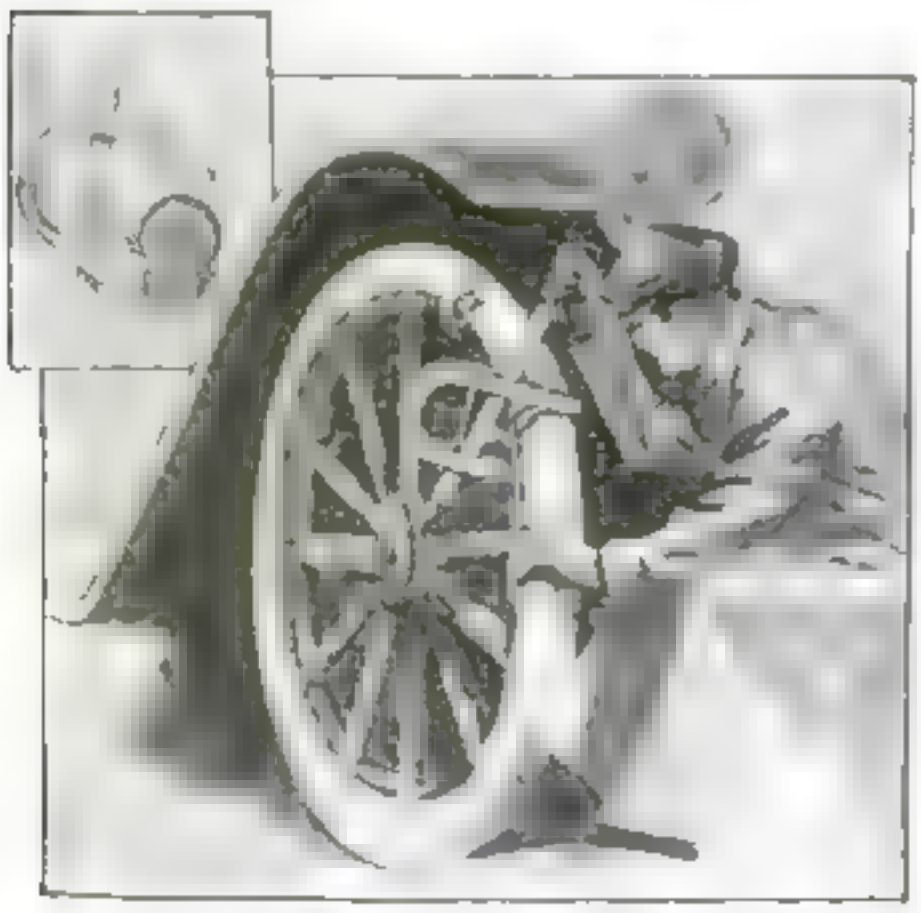
One of the most realistic bits of scenery work done by any company is a "mine." When this scene is thrown upon the screen the general opinion is that the "movie" company simply took possession of an existing mine long enough to make this picture. This mine, buildings and all, were constructed especially. It cost the company between fifteen hundred and two thousand dollars. It was built under the personal supervision of an "old timer," and it was done right. It was used in the "Master Key" serial.

A street used in "The Dumb Girl of Portici," one of the longest pictures ever made, consisting of ten reels, cost the company about ten thousand dollars. The cost here named was for the actual material used and the labor of constructing this street. The street took about three months to build.

People who attend motion picture shows are often heard to remark that "all motion picture fires are 'faked.'" That is not always so. In one film plot a fight starts in a gambling house. A bullet misses its mark and sails through a box of matches standing on a shelf. The matches ignite, the flames spreading to the walls of the building and from there along the entire street. This street cost over thirteen hundred dollars to build.

During a storm on the Pacific ocean the schooner, "Aggie," struck a rock and, after being abandoned by the crew, lay for several hours partially submerged beneath the waves. A film company saw a chance for a very unusual scene. The wreck was purchased, and a large company of actors was rushed many miles to the scene. Launches were chartered and several "takes" made. Later a thrilling play was written around these naval scenes, which, alone, ran up into the thousands of dollars.

The foregoing has to do almost entirely with the "scenery" for the pictures, the outlay for actors' salaries has not been touched upon, although it is a gigantic item. The weekly salaries of many stars are written in four figures, and most leading actors receive "several hundred per"—week.



A tool which avoids torn fingers and the still more expensive torn tire casings

Attaching Tires to their Rims Easily

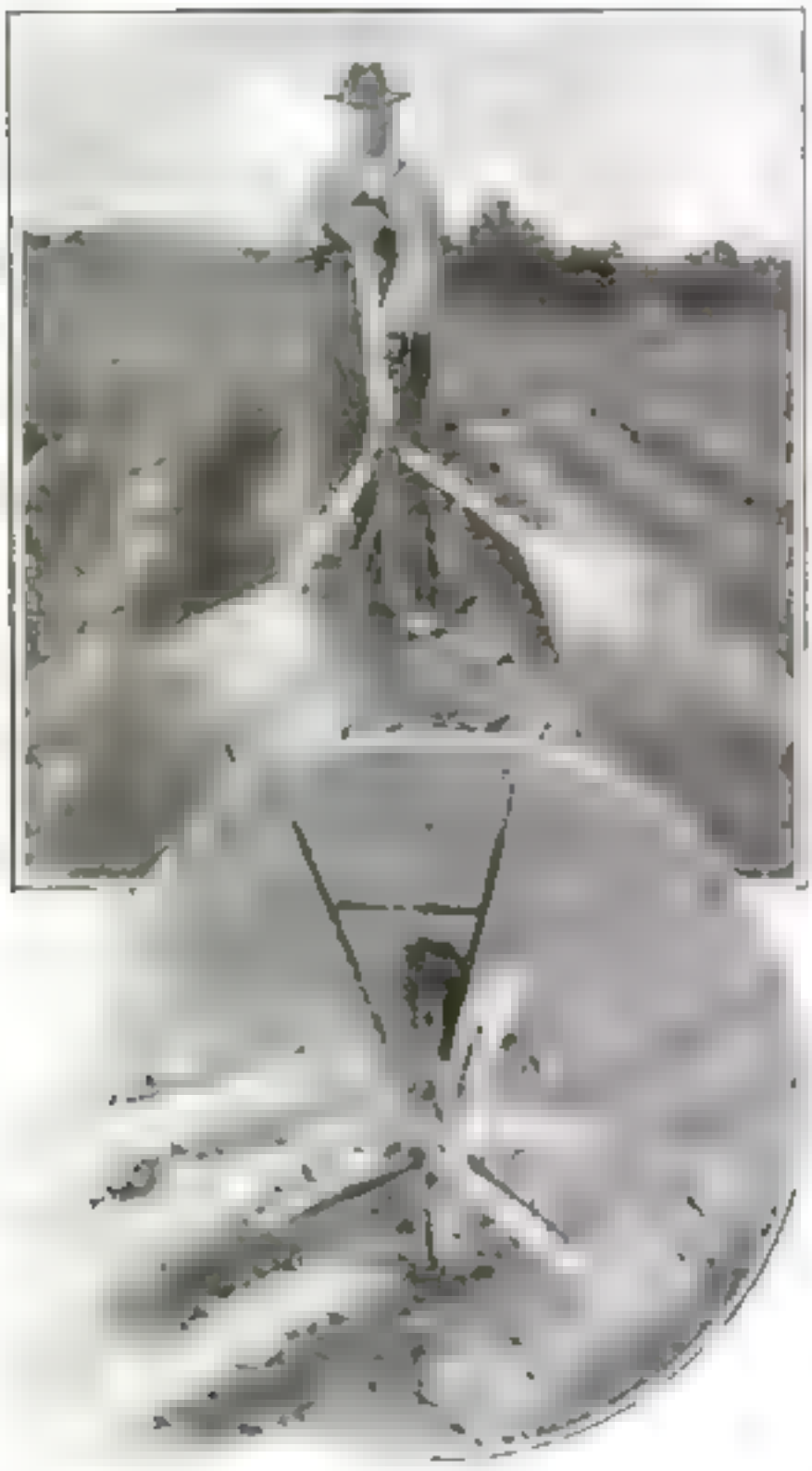
A TIRE tool for quickly attaching the casings of automobile and motorcycle tires to their rims has been brought out. A large U-shaped metal clamp passes from above the tire to the under side of the rim. A lever, with a protruding arm, swings from a pivot in the clamp against the edge of the casing that is to be forced into place. By bearing down upon the clamp, the protruding arm of the lever presses the casing into place inside the rim. A number of small holes are bored in the clamp and the lower end of the lever to adapt it for use with tires of various sizes.

Petroleum Lands in Southern California are worth millions. To acquire them for nothing from the Government, the speculator works them on the plea that they contain gypsum deposits. So they do, but the oil is what he wants. His work, done to meet Government requirements, consists in carving out the stairs and terraces seen in the illustration

Fake Gypsum Claims

ONE of the most fantastic frauds of the times is that which is being perpetrated in acquiring for nothing petroleum lands in Southern California which may be worth from $1,000 to $2,000 an acre. It consists in entering lands underlaid with petroleum under the pretext that they contain valuable gypsum deposits. The gypsum is there, it is true, but it is commercially worthless; however, with the $100 a year "assessment" for work on a claim, it is possible to hold large acreages, while in reality even this hundred dollars' worth of work on most of these claims includes a very liberal estimate for the cost of the labor performed.

The people in the oil country smile very broadly at this assessment work, and, the work accomplished is of no value and is simply to enable the oil man conscientiously to make oath to the fact that he has done or paid for having done $100 worth of work on his claim. Thus there are to be found picturesque amphitheaters and other configurations done artistically in a poor quality of gypsum, and winding stairs leading to nowhere along the hillsides and slopes of the rich California oil fields. In this manner the oil lands are held against all comers until the particular oil speculator or syndicate gets ready to sell the land or finance a company, perhaps, actually to develop it for oil. A single well in any of these great Southern California oil fields may make the fortune of the man who strikes it, some of the gushers having produced upwards of a million dollars' worth of petroleum.



The double spray for fertilizer cuts down the farmer's work one-half. The same machine can be used for planting

Fertilizing Two Rows at Once

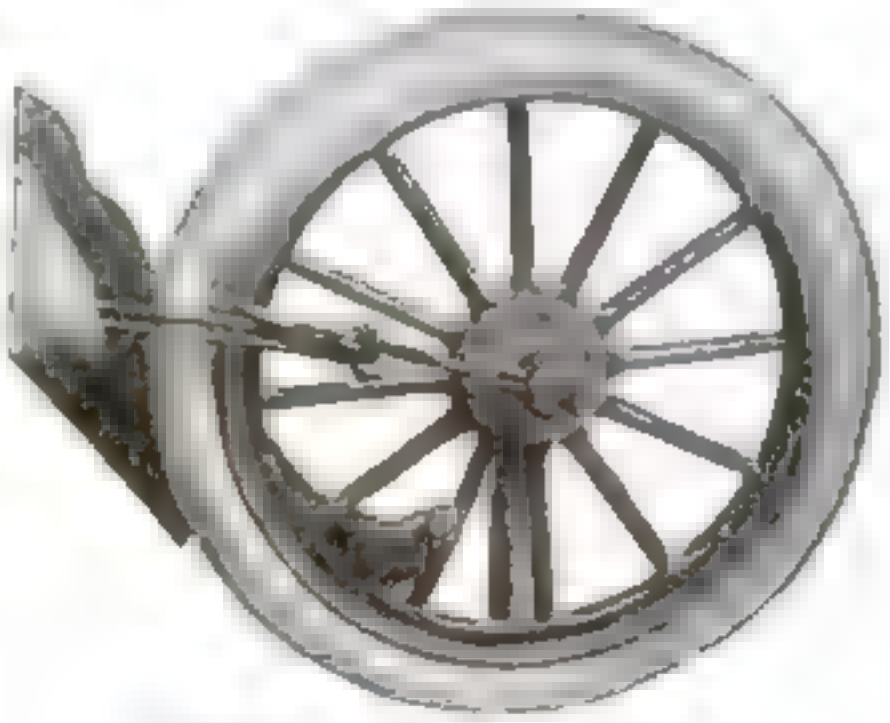
THE farmer or gardener can speed up his Spring work by putting fertilizer into two rows simultaneously instead of merely doing one row at a time. A bifurcated fertilizer spout makes it possible for one man to do the work of two. The device may be attached to any ordinary fertilizer distributer, and its spouts will deliver the fertilizer in opposite directions to the two rows. In some instances planting might also be done in double-quick time with this ingenious device.

Taking Off the Tire in a Jiffy

A TIRE tool, invented by John P. Cunningham, of York, Nebraska, simplifies the usually troublesome undertaking of removing an automobile tire from the wheel-rim. It is especially designed for use in connection with clincher tires. One person can brace his foot against the spoke and easily and quickly pry the tire off with this tool, without soiling his hands.

The device has a bar, the inner end of which is attached to a ring which fastens around the hub to act as a brace. The outer end of the bar has a peculiarly-shaped lateral offset portion, which is inserted between the edge of the tire and the flange of the rim. An operating lever is used by the autoist in conjunction with the other device. The lever has tongues that engage mid-way on the bar of the device that extends from the hub and engages under the tire. The offset portion of the device is worked along the tire by a rotary prying movement. It is then held securely by a ring device that engages around the hub. Then the autoist takes his auxiliary lever in hand, braces his foot against the spoke, spins the wheel around and off comes the tire.

It is almost equally useful in replacing the tire. The only difference is that the tire casing goes inside the upper lug of the offset portion of the tire that swings about the hub. The wheel is turned the same as in removing the tire. The offset lug, being on the outside of the casing, forces it over the rim into its proper position.



With this tool a clincher tire can be pulled off quickly and without damage by one person

The Undependable Fog-Horn

A victim of the freakish fog-signal. The British freighter "Chalcas," feeling her way past Point Wilson, at the entrance of Puget Sound, and guided by the blasts of the siren, suddenly ceased to hear the fog-horn. Before it could be picked up again, the steamer was wrecked and a loss of seventy-five thousand dollars resulted. The siren had kept blowing, but the steamer had entered one of the "zones of silence," and had ceased to hear

THE caprices of fog-horns present a less serious problem to the navigator than they did before the days of submarine signals, but as the use of the latter device is by no means universal, the erratic behavior of aerial signals is still responsible for many marine disasters.

Whether the signal be a siren, trumpet, whistle or bell, its range of audibility is subject to remarkable fluctuations. A signal under certain circumstances audible at a distance of ten miles, will on occasions be entirely inaudible at a distance of two; or, again, there will be certain zones or regions within a mile or two of the signal where no sound can be heard, while the signal is distinctly heard at much greater distances. These "zones of silence" have often been described, but never fully explained. Moreover, many misleading statements are current in regard to them.

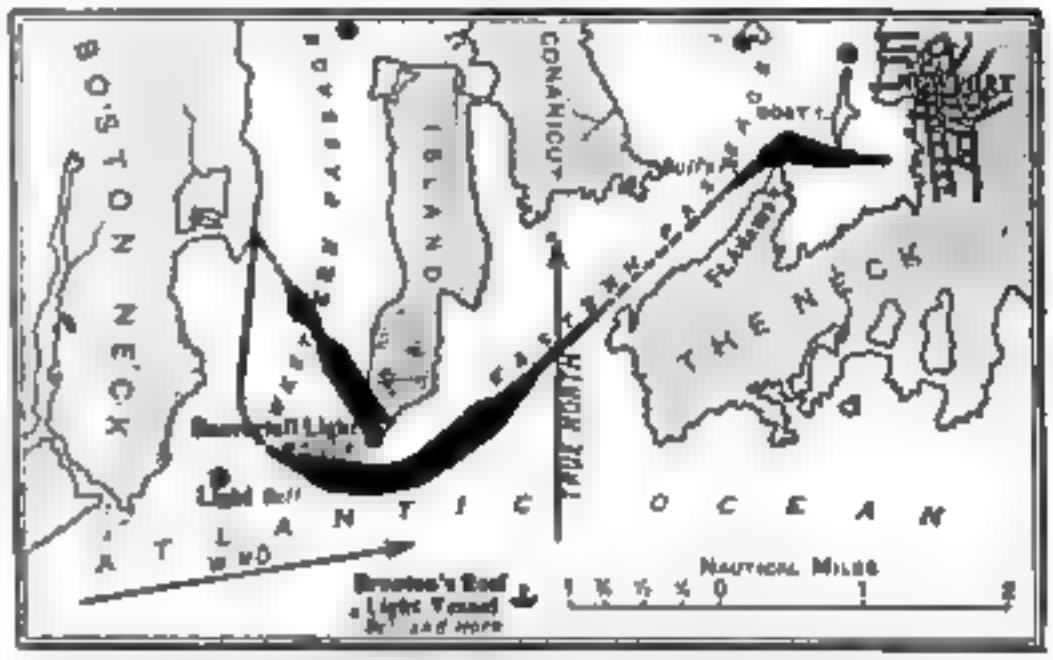
That fog has a blanketing effect upon sound was believed until disproved by the classic experiments of Tyndall at the South Foreland and elsewhere in England in the 'seventies of the last century. Tyndall proved that, in general, sound carries farther in a fog than in clear weather. In the same series of experiments this physicist developed an hypothesis to account for zones of silence and aerial echoes. This explanation lays particular stress upon a supposed "floculent" condition of the atmosphere, *i. e.*, the pressure of streams of air of mutually different temperatures and humidities, giving rise to invisible "acoustic clouds." Tyndall's hypothesis is, however, not now accepted in its entirety.

About the time of these experiments, similar investigations were carried out in America by General Duane and Professor Joseph Henry. One result of the American experiments for which the investigators themselves were not responsible, was the currency given to the idea that a "zone of silence" surrounding the source of sound is a more or less uniform and permanent phenomenon. Except under special conditions of topography, this is not the case.

A typical case of acoustic fluctuations is shown by one of the accompanying diagrams. On the night of November 6, 1880, the steamer *Rhode Island*, valued with her cargo at $1,000,000, was lost on Bonnet Point, in Narragansett Bay. This wreck occurred only a little more than a mile from the fog-signal at Beaver Tail Point—a Daboll trumpet—which was in full blast at the time, and, under ordinary circumstances, could be heard at a distance of six to eight miles. The conditions of audibility in this region were subsequently investigated by Commander (now Rear-Admiral) Chadwick, U. S. N. His observations were made from a sailboat, in clear weather. (It

should be noted that the mere presence of fog has little, if anything, to do with the eccentric behavior of fog-signals. That these acoustic caprices are associated in the popular mind with fog, and often attributed thereto, is due merely to the fact that, except for experimental purposes, fog-signals are only operated in foggy weather.)

On the accompanying chart the thickness of the line representing Chadwick's route shows the varying degree of audibility of the signal at Beaver Tail Point. The sudden fading away of the sound within a short distance of the signal was, in this case, partly the result of topography (abruptly rising ground behind the signal), and therefore a permanent condition; yet investigations made on another day, with different atmospheric conditions, would doubtless have yielded results differing to a large extent from those here shown.

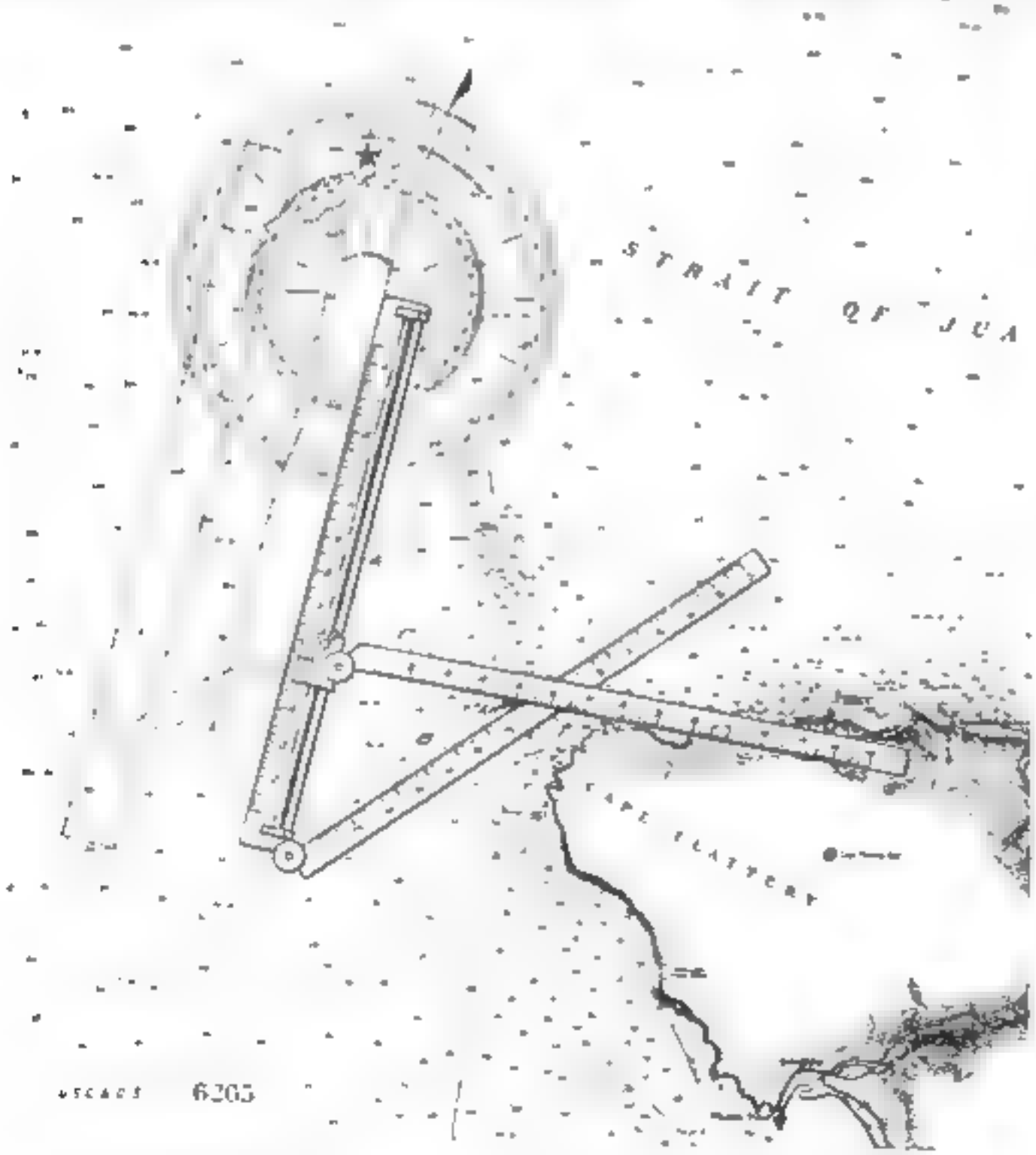


Narragansett Bay, the black lines showing how the audibility of a fog-horn fluctuated

Refraction, by the wind and by strata of different densities in the atmosphere, undoubtedly plays an important part in the anomalous behavior of fog-signals; but the subject is still obscure, notwithstanding the elaborate investigations that have been devoted to it by Stokes, Tyndall, Henry, Reynolds, Rayleigh, and many others.

The net result of the facts above set forth is that aerial fog-signals serve merely as a poor makeshift, pending the general adoption of submarine signals. Radio signals are also useful in this connection.

A device for utilizing both radio and sound signals to determine



With the fogometer, here shown, both radio and sound signals are used in determining a vessel's position in relation to the lighthouse, thus obtaining more accurate results

a vessel's position in a fog, when sufficiently near a signal station, was introduced and patented a few years ago by Capt. W. J. Smith, of Seattle. It is called the "fogometer." The use of this device depends upon the fact that the transmission of a radio signal is practically instantaneous, while a sound signal requires an appreciable length of time to travel through either air or water. Moreover, the speed of sound in air is 1,090 feet per second, at a temperature of 32° Fahr., and increases with the temperature at the rate of about 1 foot per degree. Its speed in sea water is about 4,590 feet per second.

Gaging the Distance of a Ship in a Fog by Signals

Now suppose a vessel to be within hearing distance (by aerial or submarine signal) of a wireless station on shore, the ship having a wireless outfit. If the station gives a sound signal and a wireless signal simultaneously, the distance of the ship from the station can be determined by noting the difference in time between the two signals, as received on board. Capt. Smith has prepared tables showing the distances corresponding to various intervals of time, for both aerial and submarine signals.

The construction and *modus operandi* of the fogometer will be clear from the accompanying diagram. The three rules here shown are graduated in arbitrary units representing nautical miles. We suppose a vessel to be approaching the Strait of Juan de Fuca from the southward, in a fog, within hearing distance of the lighthouse off Cape Flattery, which is equipped with wireless. First her course is laid off as to direction only, with a parallel rule. Calling the lighthouse by wireless she requests the operator to despatch wireless and sound signals simultaneously, and to repeat the dual signal at the end of thirty minutes. The first pair of signals gives the ship's distance from the lighthouse, as above explained. This is, say, 7.7 miles. After thirty minutes the second pair of signals gives the distance as 5 1 miles. The distance run in the interval is found by log to be 5½ miles. We now have the three sides of a triangle, and set the fogometer accordingly, placing the vertex of the appropriate angle over the lighthouse. We next slue the triangle around until the offshore side, *A*, conforms to the edge of the parallel rule containing the course.

Finally, we mark the chart with a pencil point through the aperture at the end of the run (the intersection of sides *A* and *C*), and take a line through this point and the lighthouse, which, with the aid of the parallel rule and the compass rose on the chart, gives us the correct bearing of the lighthouse.

The *distance* of the lighthouse at the end of the run does not, of course, actually correspond to the length of side *C*, unless it should happen that the arbitrary graduations of the rules are identical with nautical miles on the chart; but this is immaterial, as the distance is known from the comparison of wireless and sound signals, as above described.

Objections to the Use of Combined Signals

It must be stated, however, in this connection that the determination of distances from the combined radio and sound signals is, in fact, not so easy as it might, at first sight, appear to be. During the past year the United States Bureau of Lighthouses made observations from the tender *Larkspur*, cruising near the Fire Island Light Vessel, which has a 12-inch steam chime whistle and a submarine bell, and was temporarily equipped with wireless. A report on these experiments states that "the comparatively short ranges of the whistle and submarine bell lead to such a brief difference of interval between such signals and the radio signals as to make highly accurate observations by stopwatches a necessity, thus limiting the usefulness of the method from a practical standpoint."

The Bureau is experimenting to develop an efficient fog-signal using radio only.

Detecting Flaws in Steel

RECENT experiments in this country have shown that with the aid of a Coolidge X-ray tube, defects in steel castings can be detected even through metal of considerable thickness. Radiographs, not a fluoroscope, are used.

Some Jobs You Would Not Want

To get a bird's-eye view of New York city's swarming streets newspaper photographers perch on girders five hundred feet and more in the air

Painting the iron-work of a skyscraper in course of construction. One step and

Below, a steeple jack at work on the flagpole of a big New York hotel. Old time sailors were no more venturesome

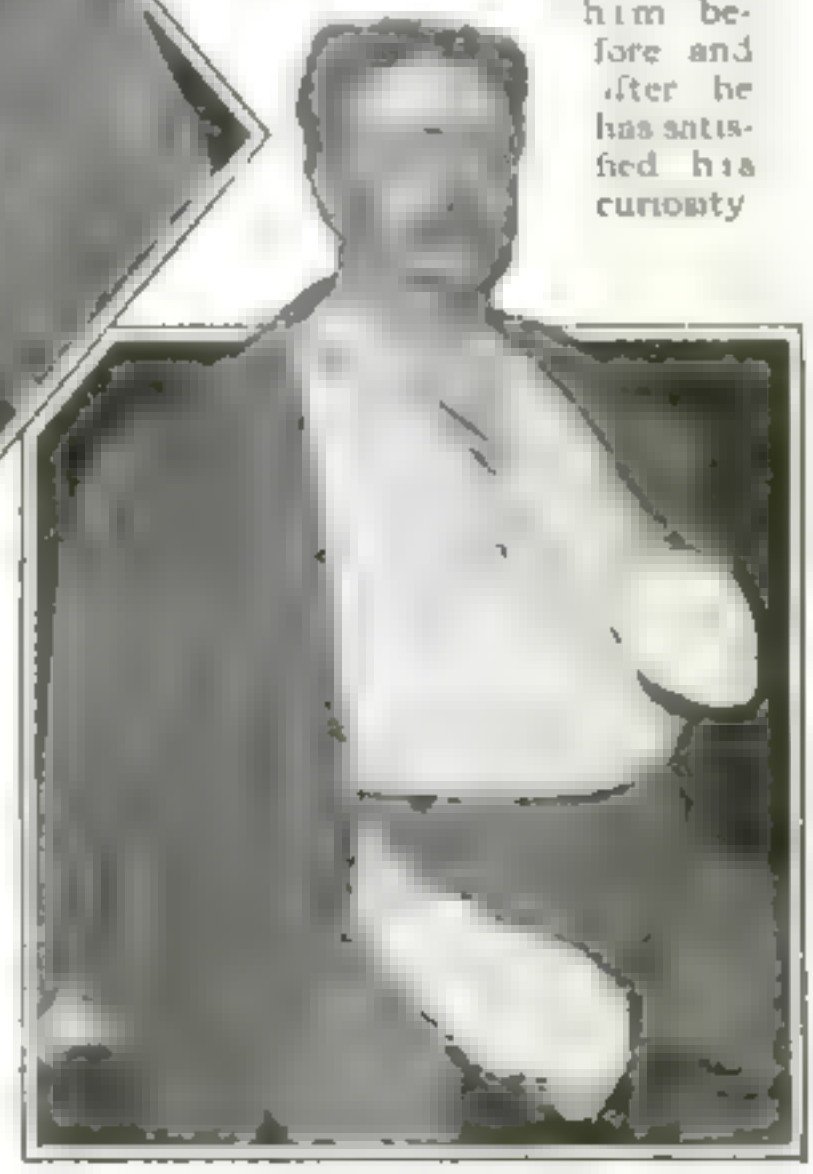
Human spiders painting the cables of Brooklyn Bridge. There is an all-year job But for their work, the bridge would long since have collapsed

Some Jobs You Would Not Want

Rodman Law makes a profession of dropping from great heights. He jumped off some of New York's tallest buildings with a parachute for motion picture companies

Diver plunging into the Chicago River to recover bodies from the "Eastland" hold. Many divers risked their lives unhesitatingly in searching for the lost

Egan, the Chief of New York's Bureau of Combustibles, opens Black Hand and anarchist bombs. The pictures to the left and below show him before and after he has satisfied his curiosity

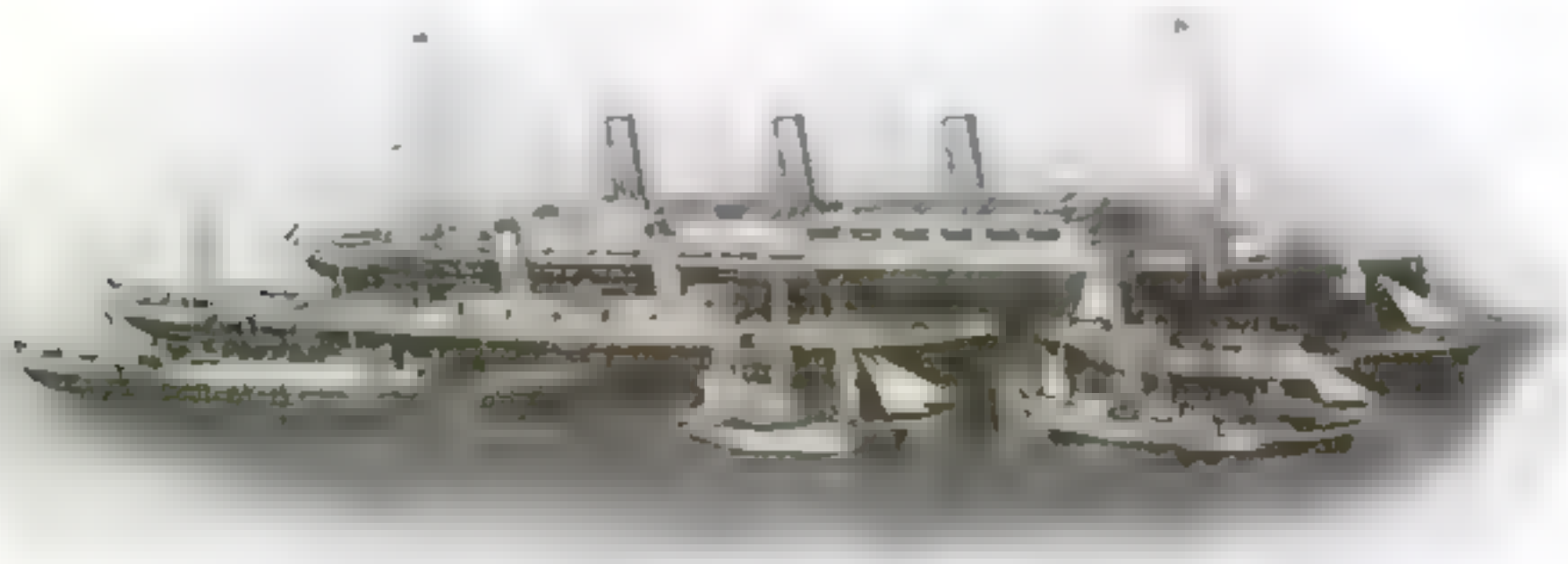


The man shown in the picture on the left he is climbing up the side of the Flat iron Building in New York city; claims that he has so perfect a sense of equilibrium that walking up a vertical wall is no more difficult for him than climbing a flagpole

Photos copyright by International Film Service

Miniature Ships That Were Built to Prove a Point

IN an effort to show the constant necessity of deepening the channel leading into New York Harbor, the War Department has had an interesting fleet of perfectly modeled miniature ships made by H. E. Boucher of New York, ranging from the S. S. *Dreadnought* of nearly a century ago to the S. S. *Vaterland* of the present day. Other miniature ships in this fleet are the *Britannic*, *Borussia*, *Arizona*, and *Oceanic*, with drafts of from sixteen feet in the case of the *Dreadnought* to thirty-eight feet in the case of the *Vaterland*.



The steamers of the world's history, in exact relative proportions, are shown in a War Department model. The whole story of the steamer's development is graphically shown in tiny compass

The intention of the War Department is to prove that the increase in size of ocean vessels with their consequent increased draft means that sea harbors, to be adequate, should be dredged continually.

Pure Water for Six Hundred Thousand People

A SYSTEM of supplying pure water to the community between Buffalo and Lake Ontario, now using the water of the Niagara River, which is contaminated by the City of Buffalo, has been planned by an engineer residing at Washington, D. C.

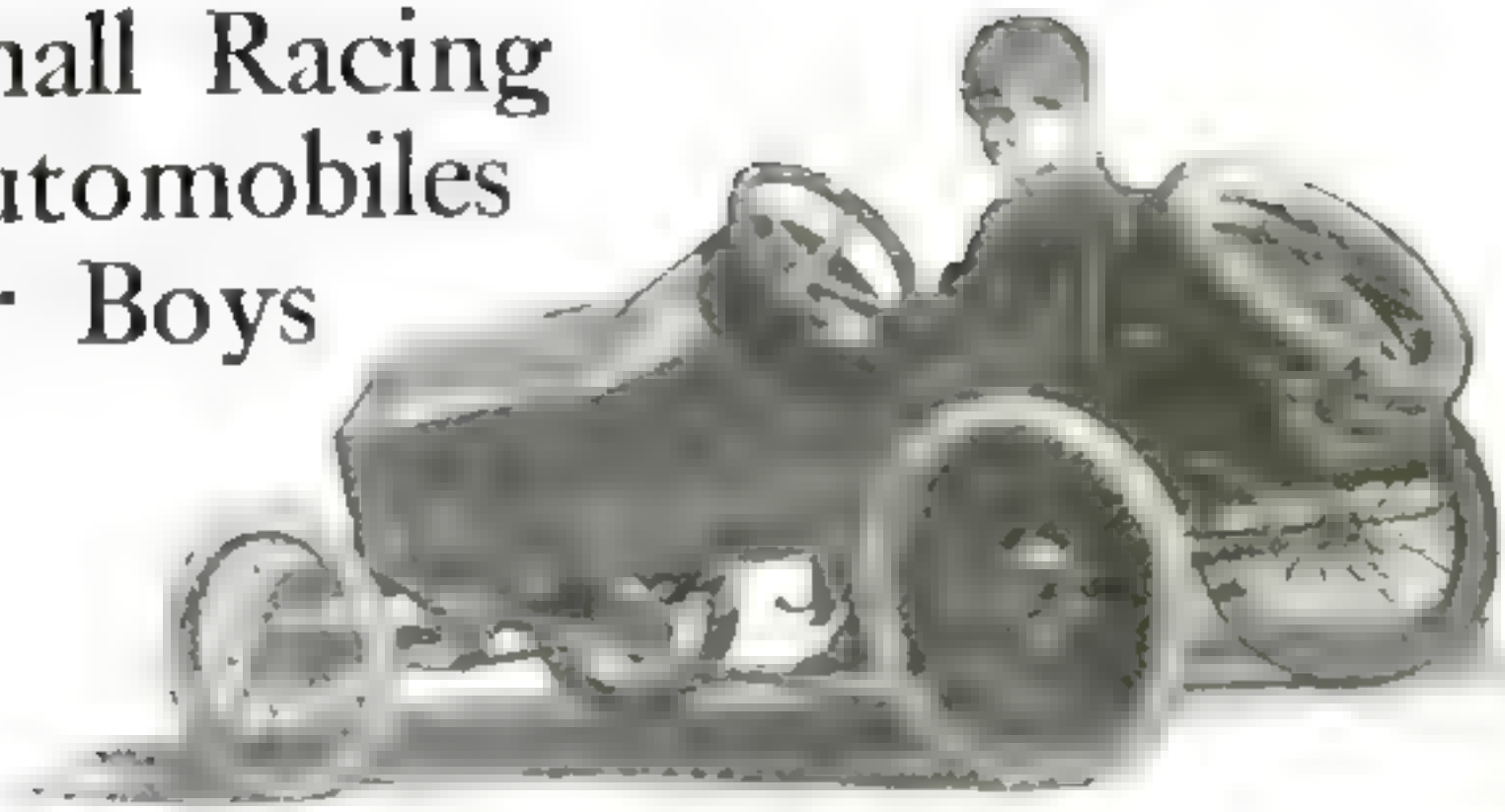
Not only will his water system furnish water to the cities on the lower level, but it will also serve as a source of power for manufacturers. Another important feature involved in his plan is to conserve the scenic beauty of Niagara Falls, which is now being seriously threatened by power plants. The scheme is to construct a canal between Lake Erie and Lake Ontario and provide adequate locks to compensate for the fall in water level so that the canal can eventually be used for traffic. More important to the people on the lower levels, however, than its use for power and traffic, is the prospect of an unlimited amount of fresh, pure water.

Numersous cities cast their sewage into Lake Erie so that its lower end is unfit for human consumption. From a technical standpoint, one of the most interesting phases of the proposed project is the way of reducing the danger now existing.

The canal will have two intakes, one above the city of Buffalo and the other below it. The latter conducts away the sewage from the city so that the towns farther down the river are most effectively immunized.

Another advantage of the canal will be its provision of a safe harbor at either end. The power plant which is proposed to do away with much of the water diversion at the Falls will be located at the end of the canal, overlooking Lake Ontario.

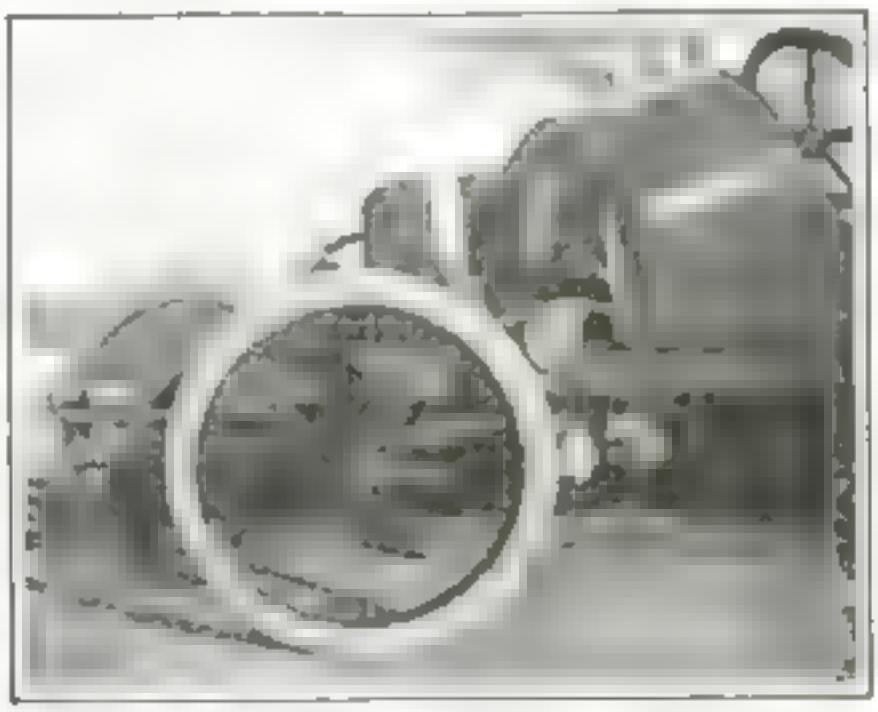
Small Racing Automobiles for Boys



A boy can now have an automobile just suited to his size

TO supply the demand for small runabouts for boys, a factory has been built in Culver City, California, where one-passenger cars are made with a simple mechanism easily mastered by a young driver. They are good for a speed of twenty miles an hour and can carry a weight of five hundred pounds.

The selected ash frame is three by one and one-half inches, with bolted angle-iron joints. The suspension is on four springs. A two-cycle engine is used, air-cooled, governor control, and the ignition is by coil and batteries. Power is transmitted by a flat belt.



Every unnecessary feature is eliminated so that a boy can take care of his car without the aid of a garage-keeper

Every needless feature is omitted in order to make a car which the small boy can learn to run, without too many complicated attachments to puzzle him. It was designed by Pendleton, the inventor of the electrical timing system of recording speeds—a man who has always taken a great interest in miniature racers

Watering the Oyster

SOME fish dealers add fresh water to oysters to increase their size. The oyster when put in fresh water will "drink" or absorb considerable water and will increase in size in proportion. As oysters are usually sold by the pint or quart, any increase in their size due to the addition of water enables the dealer to fill the measure with a smaller number of oysters.

If four quarts of oysters and one quart of fresh water are placed in a container and the mixture allowed to stand for several hours, there will appear to be five quarts of dry oysters, for the container will be full and there will be little or no water in sight, as it is on the inside of the plump, succulent looking oyster. The average purchaser has no means of detecting the addition of water. The chemist, however, by determining the amount of water in the oyster and comparing it with the amount that an oyster normally contains, can readily detect the adulteration.

Increasing the bulk with water is not confined to shucked oysters. Some dealers float the oysters for several hours while yet in the shell in fresh water.

A newspaper holder that looks like a sword, made for Army and Navy clubs

Army and Navy Clubs Please Notice

A MAGAZINE and newspaper holder made in the form of a sword has been created by a famous furniture maker of New York. A personal design of his own, it is executed by hand, and the blade is a knotted branch split down the middle and stained a French gray. The handle, like a sword-hilt, is made of woven willow and fits the hand comfortably. The whole contrivance is singularly light and easily handled, and the usual long handle of such devices, which makes it difficult to use them comfortably, is eliminated. The new newspaper holder is in fact more easily held than a paper which is not so protected.

The hilt is black, in attractive contrast to the gray of the "blade." The device has already found its way into many clubs.

Music While You Work

A DRY-CLEANING establishment in Cincinnati has come to the conclusion that if its employes hear music at frequent intervals while they work it will not only make them happier, more contented and better workers, but that they will accomplish more than if they were without it.

Working upon this theory, there have been installed throughout the big establishment enough phonographs to keep lively music playing most of the day

The records are selected with care, lest a funeral selection, a dreamy waltz, or a Sextette from Lucia should creep in. There are many lively dance records and popular songs. The workers hum and sing to the lively music and the speed of the music puts the speed into their work

The music-while-they-work is said to be a South American idea, where music is recognized as a necessity of life.

If the regimental band makes soldiers step lively, why shouldn't this phonograph make ironing easier?

A Motion-Study Stopwatch Which Does Its Own Computing

IN the factory and other industrial establishments where accurate data are demanded as to costs and the time of mechanical operations is required, the stop-watch has become as much a part of the equipment of the plant as the engine or motor which drives the machinery. For a long time the ordinary stop-watch which was designed for the race-track was employed. It answered the purpose, but after it had been used the real work began. It was necessary to enter into a more or less lengthy computation in order to arrive at the output per hour or day.

There has been recently introduced into this country, from the factory of a Swiss watch-maker, a time-study watch by which it is possible to arrive at the conclusion directly without resorting to the use of paper and pencil or even undertaking any mental calculation. It answers the demands of the professional rate-setter as well as the factory manager who wants only a reasonably close approximation. The dial is divided into tenths and hundredths and in addition to these desirable features, it contains figures spaced two-hundredths of a minute apart to indicate at any point of elapsed time exactly what the corresponding output per hour is. If the hand is stopped over .36 of a minute, the reading directly under it shows that the output is 167 per hour.

In the manufacturing business it is often desirable to know exactly what time is required in the performance of a particular piece of work. When an employee sees that the stop-watch is being held on him he will often lag so as not to set too swift a pace for himself. By the use of this watch it is possible to determine accurately the exact time spent in "loafing" and that actually required to perform the operation. Assuming that an employee performs a certain group of movements in an elapsed time of eleven minutes, a part of which time is known to have been wasted. The observer will follow up his first observation with another, stopping the watch during the fractions of the minute which the employee wastes by unnecessary movements or loafed time, the result obtained will be the actual time required for the performance of the task under investigation. The watch is started and stopped by the movement of the slide on the edge of the watch. For rapidly calculating time in efficiency tests, this watch cannot be equaled.

With this watch the workman can fill out his time sheets accurately, and allow for an exact counting of time cost, which before has been an uncertain quantity in auditing

A Suitcase on Wheels

PORTERS and ambitious boys are wishing that some kind censor would prohibit the manufacture of a new suitcase carrier, for should the use of this ingenious device spread broadcast, the familiar cry, "Carry your bag, Mister?" will become a thing of the past.

A pair of wheels is set on a standard that may be quickly fastened to a suitcase, as shown in the illustration. An extra handle is attached to the end of the case, and the bag is wheeled along the ground with no more exertion than is required to wheel a riderlessbicycle.

No need to hire a red-capped porter if you have wheels like these on your suitcase

A farmer built a record silo tower and now finds that a windmill on top catches every breeze that blows

A Silo and Windmill Tower in One

SILOS have been built by the thousands within the last few years, but few farmers have made use of the combination shown in the illustration. This is a two hundred-ton silo of hollow-tile block construction which supports the farm's windmill tower. The photograph shows how the silo is filled with green corn in the autumn.

The silo walls, five inches thick, are made of hollow clay blocks, with each mortar joint re-enforced by a heavy wire. The door-frame is of concrete re-enforced with vertical rods, to which the wall-re-enforcing is tied. The roof is of concrete and metal lath, thus making the entire structure fire-proof, and wind-proof. Dead-air spaces make the walls impervious to moisture and reduce the loss from freezing to a minimum.

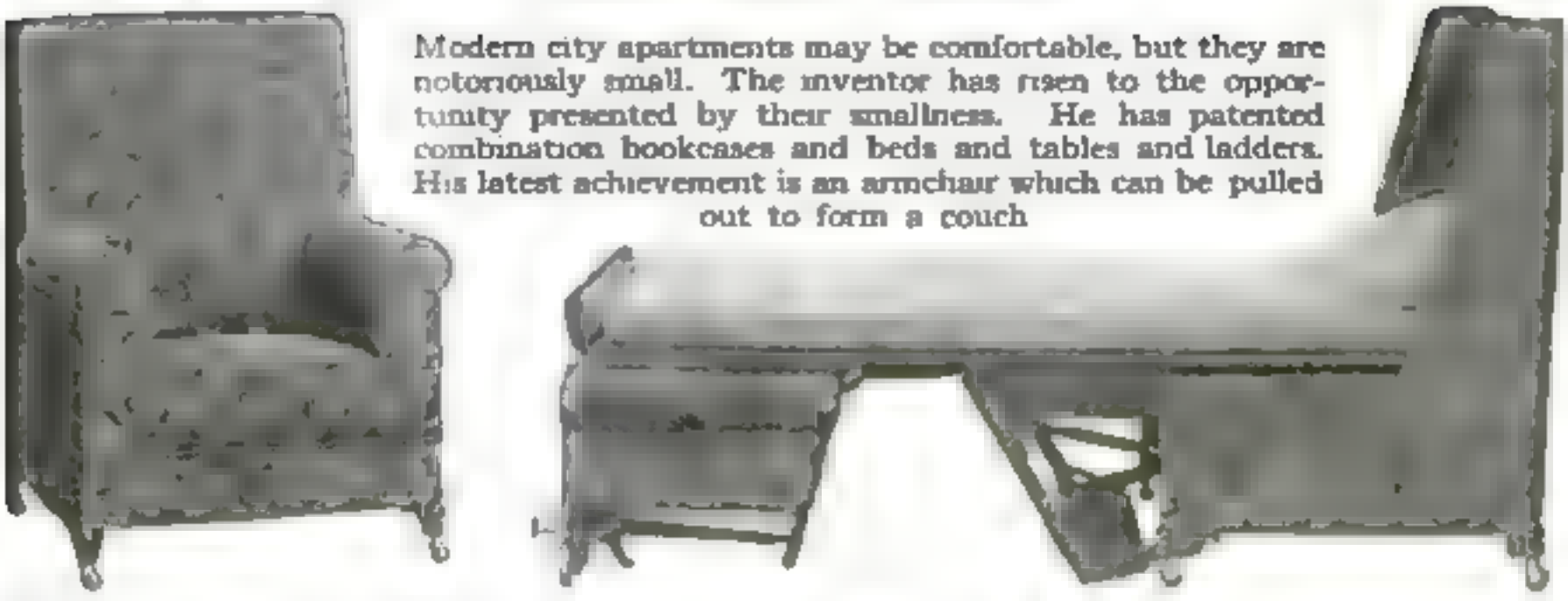
It is now a common practice among farmers to buy a twelve or fourteen-inch cutter co-operatively and to use it on five or six jobs in a season in filling silos. Such outfits have a capacity of from eight to ten tons per hour. One corn-binder is required in the field to keep the crew busy. Two men are employed in the field loading the cut corn bundles, and from three to five teams are needed to haul the corn to the cutting machine at the silo. This method has proved to be the most generally practised throughout the corn-belt states.

A Magnetic Machine Which Saves Waste Iron

IN order to separate the tiny grains of ore from the lumps of gravel and sand, after the final washing process, thereby saving iron that would ordinarily go to waste, a magnetic ore machine has been developed which may substantially increase the income of mining properties.

The sand, gravel and finely divided iron particles are washed through a long trough beneath which a series of powerful electromagnets are situated. As the liquified mass slowly flows forward, the iron grains are drawn to the bottom of the trough and retained, because of the power of the magnets, against the floor of the containing walls.

Iron in the water is caught on the magnetized walls of the sluice box, with a saving of many hundreds of dollars



Modern city apartments may be comfortable, but they are notoriously small. The inventor has risen to the opportunity presented by their smallness. He has patented combination bookcases and beds and tables and ladders. His latest achievement is an armchair which can be pulled out to form a couch

This Chair Does Duty Twenty-four Hours Every Day

IN this day of compactness, both in cramped city flats and suburban bungalows, a piece of furniture serving two purposes is in demand. A chair has been designed which, in emergencies, converts a parlor or dining room into a bedroom. It may do regular service in any room when a family has outgrown its bedrooms and cannot afford the additional rent of a larger apartment.

As a bed this chair, which does duty twenty-four hours a day, has good steel springs and a real mattress. It is large enough even for a tall man. It is opened by a single motion.

Finger-Saving Nutmeg-Grater

THOUGH a cook has ten fingers, that does not lessen the pain if one of them be hurt. Grating nutmeg in the old-fashioned way often means grating fingers in an old-fashioned way. To avoid this a little device is available for the up-to-date cook.

A metal case holds the nutmeg and a cap presses it firmly against the rough, abrading surface. All the cook has to do is to hold the handle of the contrivance safely in one hand while turning a little crank with the other. The rotary motion makes the grating continuous and rapid and one's finger tips need never touch the grater.

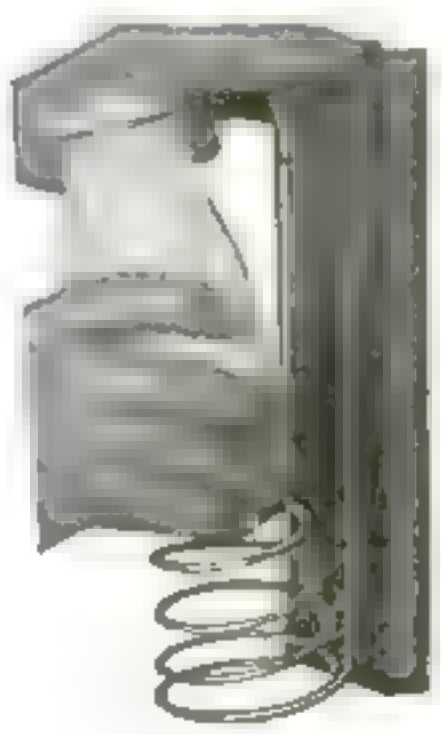
Though designed especially for nutmegs, this little device may also be used for grating other small objects, such as vegetables.

To Take Olives from a Bottle

AN implement which is used to secure the elusive olive in the bottle is shown in the illustration. It may also be used to remove cherries, pickles, chow-chow, lump sugar, nuts and the like. It clasps small objects firmly and eliminates the trouble of fishing in the bottle in a vain endeavor to spear the contents.

A Holder for Milk Bottles

HERE is a holder for the milk bottle that will save stooping, for the holder can be attached to the wall or door post. A pair of looped arms at the top forms a spring-clamp to engage the neck of the bottle. The spiral spring in which the holder terminates provides a support for the bottom of the milk bottle, holding it firmly in place.



Mark Your Golf-Ball with Your Initials

A MARKER used for stamping the initials of the owner on golf-balls is shown in the illustration. Either two, three, or four initials may be marked. The type is inked by rolling the pad over it; then the lever is pressed firmly down, the middle finger in the ring giving sufficient purchase. If desired, the ball may be marked in two or more places.

The marked balls are very useful in preventing disputes as to ownership on crowded public courses, but also serve to clear up doubtful points as to ownership of lost balls and the like on private grounds.

Interchangeable Motor-Car Grease-Capsules

OIL holes on automobiles are a thing of the past and the later screw-down grease-cup, now universally used on automobiles, is apparently doomed to oblivion because of an exceedingly simple and effective device invented recently by an Englishman. It consists of a collapsible lead capsule, which is screwed on to parts that need grease lubrication, in place of the grease cup. Finger pressure on the capsule is sufficient to force grease into the bearing or part to be lubricated, and when the capsule is emptied a new, ready-filled one is screwed in its place. The old one is thrown away. No dirt, no grease, no loss

The screw-thread, which takes the capsule and keeps it firmly during travel, is fastened to the part, instead of the grease-cup. It is made of brass and forms a grease-tight joint. Most of the parts lubricated by grease-cups are out of sight on the automobile, but even where visibility is desirable, the collapsible tubes can be used. It would be necessary to provide them with light brass or plated caps, where they are in exposed positions.

New Device Distills Water for the Home

FOR the housewife who wishes to make sure that her family is drinking pure water, a new water distiller, recently placed on the market, should prove acceptable. The device is made of copper and is lined throughout with tin, as this metal is chemically unaffected by distilled water. The still consists of three drums, which comprise the boiler, the reservoir for distilled water, and the condensing chamber

To obtain distilled water, the boiler and the cold water chamber are filled, and the still is placed upon the stove. The distilled water falls into the reservoir through a water seal. This seal is an important improvement, because it confines the steam from the boiler, thus increasing the pressure in the condensing-chamber and giving twenty-five per cent more condensation for the same amount of heat. The distilled water may be drawn off at any time through a faucet, the water in the cooling-chamber flowing into the boiler to take the place of that drawn off.

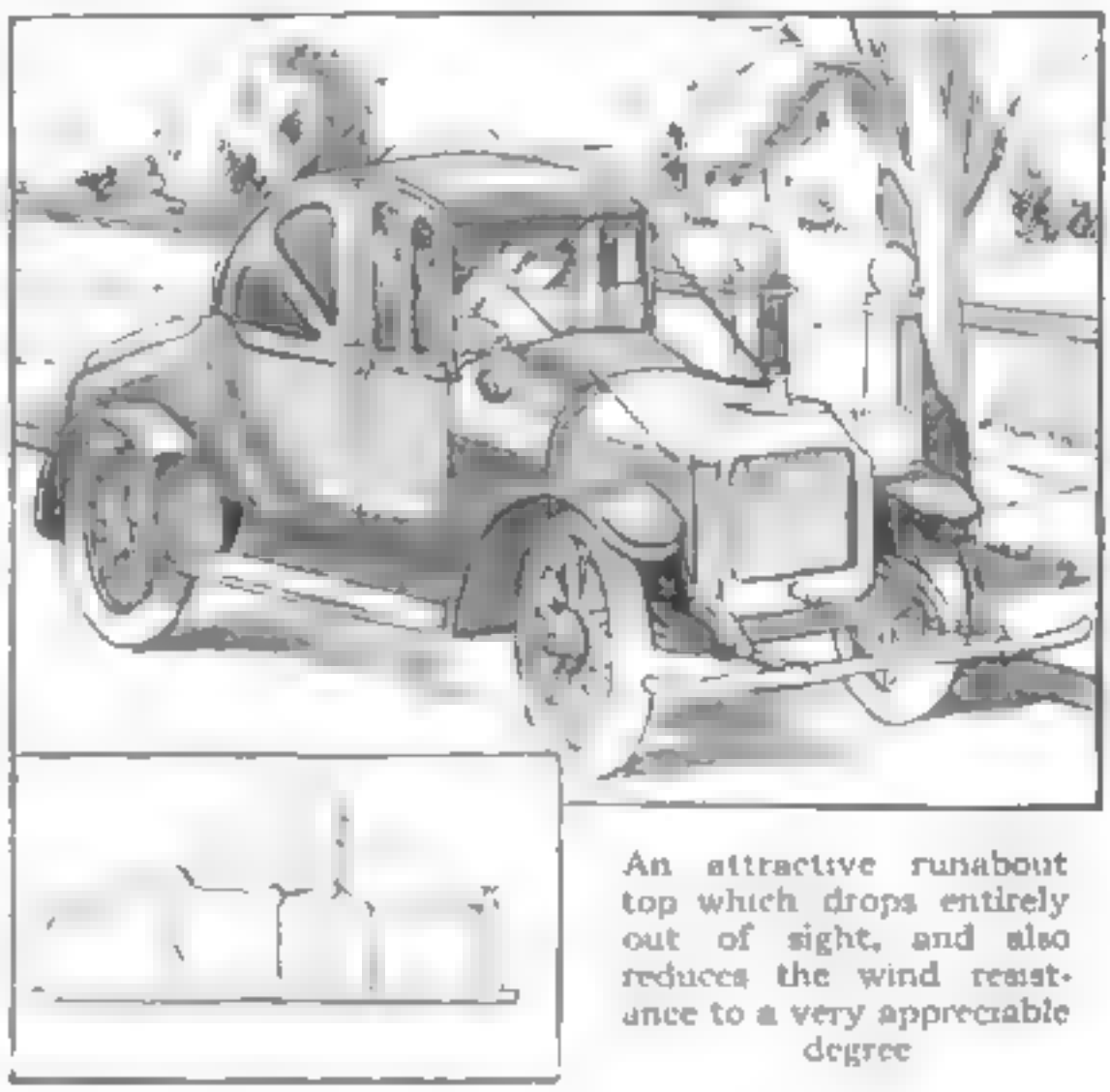
Deep Center-Punching

IN the boiler shop, where heavy center-punching is done, as on heavy tank and boiler heads and plates, the laying-out may save time and physical energy by the use of a center-punch that fits into a light pneumatic calking hammer. This can be easily made from any of the various air-tools that have been discarded

A Disappearing Automobile Top

AN automobile top that drops out of sight behind the driver and passengers when not in use is the ingenious idea that a Colorado man proposes for the automobile manufacturer who desires in his product the utmost in simplicity of appearance. Another advantage of this top is the decrease in wind resistance of the car.

No part of the top protrudes from the car when it is down. The top is circular, being pivoted at either side. The pressure of small levers is sufficient for raising and lowering it with little difficulty. For touring car bodies two tops are necessary, one of which drops into a depression behind the driver's seat, the other disappearing into a similar pocket behind the rear seat.



An attractive runabout top which drops entirely out of sight, and also reduces the wind resistance to a very appreciable degree

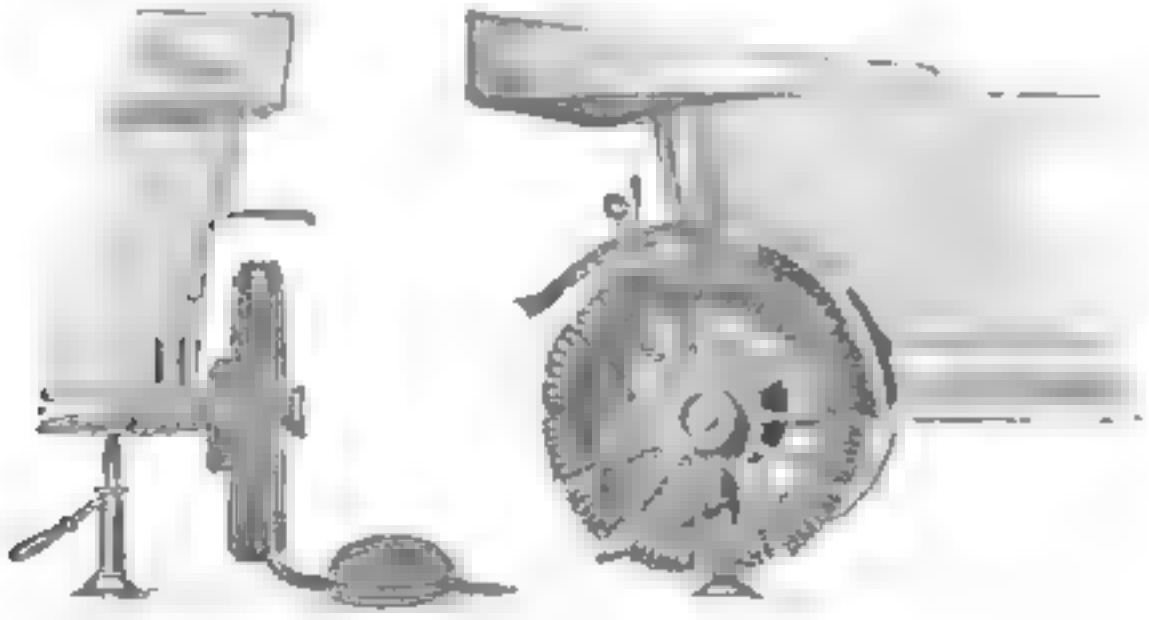
An Emergency Tire Made Simply of Rope

WHEN a blowout occurs on the road and no spare tube or shoe is on the car and the blown tube or casing is beyond further repair, the usual method of procedure is to run to the nearest garage on the rim. In every case this means positive destruction of the rim, if the casing is removed, and the serious damage of the rim or the destruction of the shoe, if it is left on the rim in an entirely deflated condition.

The inconvenience caused by the accident may be eliminated to a great extent by following the tactics of a driver who, instead of running in on the bare rim, purchased some rope from a nearby farmer and wound it tightly around the rim, felloe and spokes, as shown in the accompanying illustration. The first few turns of rope were wound circumferentially; the remainder was wound crosswise, so that holding places were obtained at four or five spokes. Sufficient rope was used to make the thickness of the novel tire equal to that of the rubber casing.

If properly wound, the rope-tire will not make riding very uncomfortable; in any event it is better than destroying a rim.

Many drivers, instead of using a covering of rope or other material, have been successful in saving the rim by stuffing the blown-out outer casing. In a few instances, grass or straw has served the purpose well, and in others old rags or other soft material, such as paper.



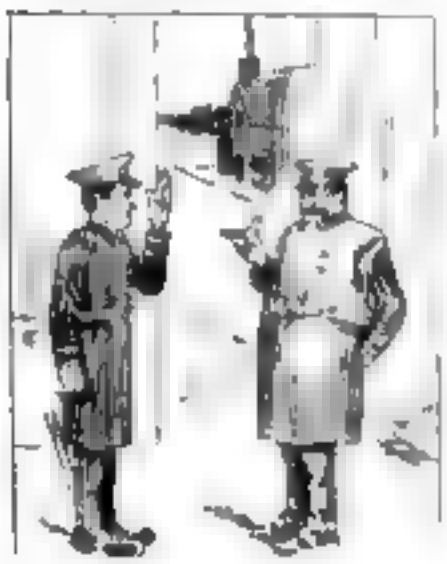
A rope will get you home safely when you have a blowout, if you follow directions given above

A Medley of Puzzles

By Sam Loyd

Off His Beat

"WHAT time of the morning is it?" asked the roundsman. It was then that Finnegan's mathematical bump stood him in good stead; for, being a few minutes late on his beat, he clouded the situation with the following truthful reply.



"Just add ¼ the time from midnight until now to ½ the time from now until midnight, and it will give you the correct time."

Can you figure out the exact time Finnegan made his speech?

Cheese and Crackers

CHEF LOUIS is showing the exact ratio in which cheese and crackers should be consumed. Says Louis:

"The balance board, which weighs ½ as much as the cheese has 4/5 of its length on one side of the balance point. Now what is the ratio between these quantities of cheese and crackers?"

This problem is literally a lesson in "balanced rations," which you can easily solve by a simple algebraic principle.

At the Auto Races

AN interesting question arose the other day at the Auto Races when three of the speed experts started on a hundred-mile race. A member of the sporting fraternity offered the odds of 20 to 1 against anyone's guessing the complete result of the contest. While the odds appeared to be surprisingly generous, an onlooker who prides himself on his aptness at figures claimed the bookmaker would have the advantage of such a wager.

Remember that one, two or all three of the cars might fail to finish. Then again, that all three might cross the finish line together, or that two might finish in a dead heat, etc.

Can you figure out in just how many varied ways the race might have terminated?

At the Stamp Window

UNCLE SAM'S postal clerks in an ordinary day's turn at the stamp window are confronted with all sorts of perplexing problems which they are expected to solve off-hand without betraying the mental gymnastics required.

One of these bright young men tells how the other day the cashier of a large mail-order house which buys in quantity, tossed a banknote through his window and said:

"Give me some 1-cent stamps; three-fourths as many 2's as 1's, three-fourths as many 5's as 2's and five 8-cent stamps for the balance of the money."

Can you tell the denomination of the banknote?

The postal clerk did not even have to use a pencil and paper, though you may, if necessary.

CASH PRIZES FOR PUZZLE SOLUTIONS

Fifteen Dollars in prizes will be awarded for solutions of the puzzles appearing on these two pages. The first prize of Five Dollars will be paid to the reader who makes a perfect score. Ten prizes of One Dollar each will be awarded to the first ten who send in meritorious answers. Should there be more than one perfect set of answers, the first prize will be paid to the reader whose letter was mailed first the postmark will guide us in determining the mailing date. Answers to the April puzzles will appear in the May number. Names of the winners of the prizes in the June number.

Send solutions to Sam Loyd, Care POPULAR SCIENCE MONTHLY

The solution of the March Puzzles appear on the opposite page. The names of the winners of the March prizes will appear in May.

Juggling the Digits

THE schoolmistress set a very pretty problem in simple addition for her class when she said, "I want you to arrange the digits 1, 2, 3, 4, 5, 6, 7, 8 and 9 and 0 in a sum which will total 1916. The use of fractions, proper or improper, is permissible so long as the sum total, when finished, will be exactly 1916."

Can you juggle the digits into the desired arrangement?

How Old Was Jimmie?

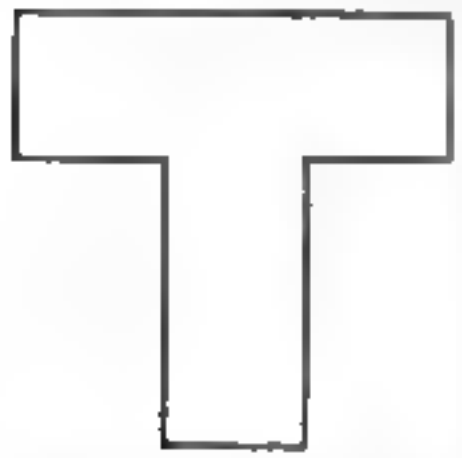
ON registration day in the public schools Jimmie Jones, brother of the famous Ann, smoothed down his hair and looked somewhat quizzically at the teacher when she asked him how old he was. Finally he replied:

"When I was born my sister was one-fourth the age of mother; sister is now one-third as old as father and I am one-fourth of mother's age. In four years I shall be one-fourth as old as father."

How old was Jimmie Jones?

Dividing the Farm

FOUR heirs to a piece of land formed like the accompanying outline of the letter T, brought their plans to a surveyor's office for instructions in carrying out provisions of the will, which were that each heir was to receive a piece of land of a uniform shape and size. The surveyor gave them the startling information that it was impossible to divide the actual land according to the terms of the will, but that he could divide the paper plan of the property so that it would conform to the terms, that is, he could cut the diagram into four pieces of the same shape and size.



Can you show how he accomplished this task?

On the African Firing Line

THE Zulu Chief found a cocoanut and threw it at the monkey. Said the monkey as he threw two in return, "I can't catch but I am great on the pitch."

Every time the Zulu threw one cocoanut the monkey tossed back two

Since all the cocoanuts used in the engagement can be seen in the picture, who can tell just how many cocoanuts the Zulu had thrown when the artist snapshot him?

Answers to March Puzzles

THE PRESIDENTIAL PUZZLE

Candidate D jumps to square 7, removing man A; E jumps to square 8, removing B; C jumps to square 4, removing E and C again jumps to 10, removing D; F then jumps over C and lands in the White House on square 5.

PUZZLING KUGELSPIEL

Analysis will show that the first player must knock one pin from the 8 group, leaving groups of 7, 3, 4. He will then be able in successive plays to leave the following winning positions against his opponent: (2, 4, 6) (1, 4, 5) (1, 2, 3) (1, 1, 1) or the doubles (4, 4) (3, 3)(2, 2).

THE COST OF A VILLA

The Smiths' new home cost $2,253. The paper-hanger's bill was $148; the painter's, $230; the plumber's, $260; the mason's, $420, and the carpenter's, $444, a total of $1502. The lot cost $751.

AN ELEPHANT ON HIS HANDS

The data of that unconsummated elephant deal reveals the fact that the would-be seller asked five rupees for his animal, and that the prospective buyer's best offer was less than nothing, for he asked a bonus of three rupees to take the beast, which you see would be eight rupees less than asking price. Then the seller came down twenty per cent to four rupees, but there remained a difference of seven rupees between them and no deal

My Adventures as a Spy

By Lt.-Gen. Sir Robert Baden-Powell

The author of this article is a famous British officer. Having joined the 13th Hussars at the age of nineteen, he served in India and South Africa, became distinguished in the Matabele campaign in 1896–7, and won fame in the Boer War for his brilliant defense of Mafeking in spite of famine, sickness and the lack of troops. None of his varied experiences are more interesting, however, than his exploits as a spy. Many of these episodes are related in his latest book ("My Adventures As a Spy," J. B. Lippincott Co.), from which this article is taken. Editor.

IT has been difficult to write in peace-time on the delicate subject of spies and spying, but now that the war is in progress and the methods of those much abused gentry have been disclosed, there is no harm in going more fully into the question, and to relate some of my own personal experiences.

These hieroglyphics contain a secret message which can be easily read by those who know the semaphore signaling code, which consists of swinging two arms in different positions, either singly or together. The dots indicate where the letters join. For example: The semaphore sign for N consists of both arms pointing downwards at an angle of 90°. The letter I is shown by both arms pointing to the left at the same angle. The next N is shown again, and the letter E is a single arm pointing upwards on the right at an angle of 45°. In each word you read downwards.

As a first step it is well to disabuse one's mind of the idea that every spy is necessarily the base and despicable fellow he is generally held to be. He is often both clever and brave. Let us for the moment change the terms "spy" to "investigator" or "military agent." For war purposes these agents may be divided into:

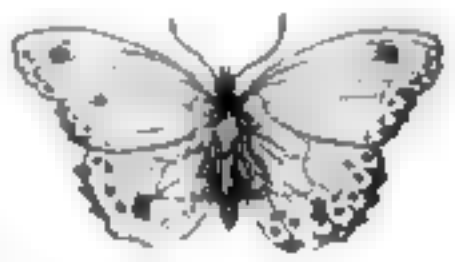
1. *Strategical* and diplomatic *agents*, who study the political and military conditions in peace time of all other countries which might eventually be in opposition to their own in war. These also create political disaffection and organize outbreaks, in order to create confusion and draw off troops in time of war.

2. *Tactical*, military, or naval *agents*, who look into minor details of armament and terrain in peace-time. These also make tactical preparations on the spot, such as material for extra bridges, gun emplacements, interruption of communications, etc.

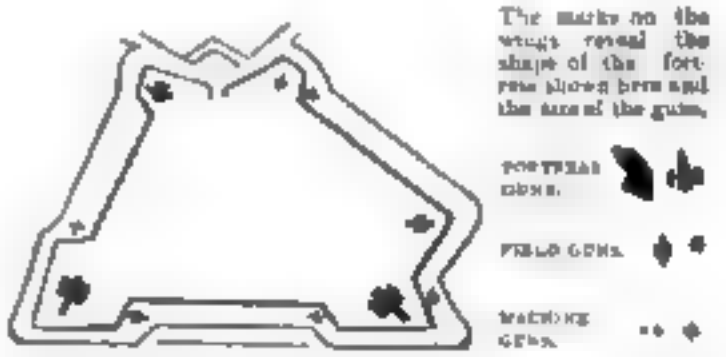
3. *Field spies.* Those who act as scouts in disguise to reconnoiter positions and to report moves of the enemy in the field of war. Amongst these are residential spies and officer agents. There are also traitor spies. For these, I allow, I have not a good word. They are men who sell their countries' secrets for money.

Tactical Agents

In addition to finding out military details about a country, such as its preparedness in men, supplies, efficiency, and so on, spies have to study the tactical features of hills and plains, roads and railways, rivers and woods, and even the probable battlefields and their artillery positions, and so on. The Germans in the present war have been using the huge guns whose shells, owing to their black, smoky explosions, have been nicknamed "Black Marias" or "Jack Johnsons." These guns require strong con-



This sketch of a butterfly contains the outline of a fortress, position and power of guns. Only the marks *on* the lines are significant



The position of each gun is at the place inside the outline of the fort on the butterfly where the line marked with the spot ends. The head of the butterfly points towards the north

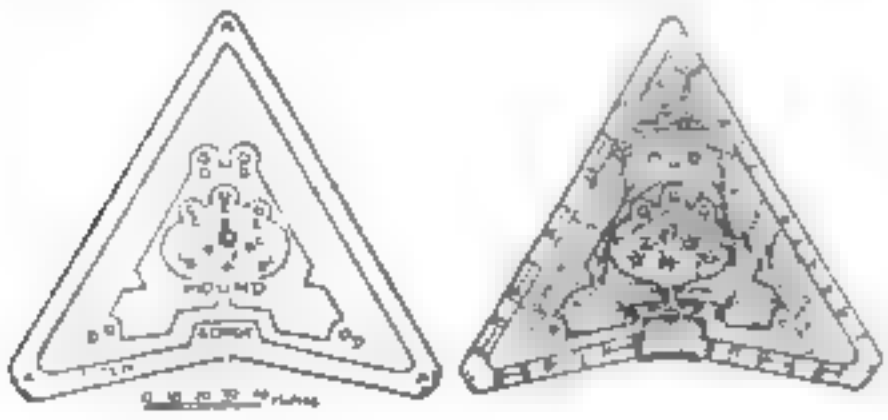
crete foundations for them to stand upon before they can be fired. But the Germans foresaw this long before the war, and laid their plans accordingly.

A smart piece of spy work. Veins on an ivy leaf show the outline of the fort. The tip of the leaf indicates north

They examined all the country over which they were likely to fight, both in Belgium and in France, and wherever they saw good positions for guns they built foundations and emplacements for them. This was done in time of peace, and therefore had to be done secretly. In order to divert suspicion, a German would buy or rent a farm on which it was desired to build an emplacement. Then he would put down foundations for a new barn or farm building, or—if near a town—for a factory, and when these were complete, he would erect some lightly constructed building upon it. There was nothing to attract attention or suspicion about this, and numbers of these emplacements are said to have been made before war began. When war broke out and the troops arrived on the ground, the buildings were hastily pulled down and there were the emplacements all ready for the gun-

Officer Agents

It is generally difficult to find ordinary spies who are also sufficiently imbued with technical knowledge to be of use in

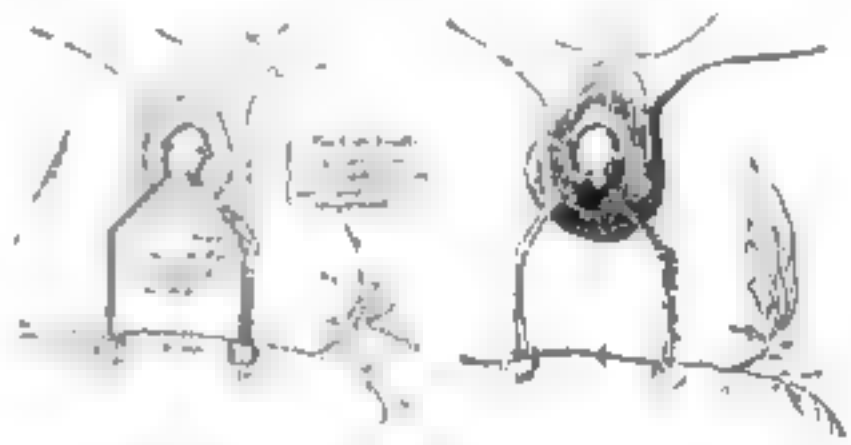


A sketch of a triangular fort was transformed into a stained glass window design, with certain of the decorations signifying the location and sizes of guns

gaining naval or military details. Consequently officers are often employed to obtain such information in peace time as well as in the theater of action in war. But with them, and especially with those of Germany, it is not easy to find men who are sufficiently good actors, or who can disguise their appearance so well as to evade suspicion. Very many of these have visited England's shores during the past few years, but they have generally been noticed, watched, and followed, and from the line taken by them in their reconnaissance it has been easy to deduce the kind of operations contemplated in their plans.

Catching a Spy

Spy-catching was once one of my duties, and is perhaps the best form of education towards successful spying. I had been lucky enough to nail three and was complimented by one of the senior officers on the Commander-in-Chief's staff. We were riding home together from a big review at the time that he was talking about it, and he remarked, "How



The sketch on the left was made, giving all the particulars wanted. To bury it in such a way that it could not be recognized as a fortress plan if the spy were caught by the military authorities, it was turned into a sketch of a moth's head. Underneath in the note-book was written. "Head of Dula moth as seen through a magnifying glass. Caught 19.5.12. Magnified about six times size of life" (Meaning scale of six inches to the mile.)

do you set about catching a spy?" I told him of our methods and added that also luck very often came in and helped one. Just in front of us, in the crowd of vehicles returning from the review-ground, was an open, hired Victoria in which sat a foreign-looking gentleman. I remarked that as an instance this was the sort of man I should keep an eye upon, and I should quietly follow him till I found where he lodged and then put a detective on to report his moves.

From our position on horseback close behind him we were able to see that our foreigner was reading a guide book and was studying a map of the fortifications through which we were passing. Suddenly he called to the driver to stop for a moment while he lit a match for his cigarette. The driver pulled up, and so

An instance of how an effective disguise can be assumed on the spur of the moment. This disguise was effected in two minutes

did we. The stranger glanced up to see that the man was not looking round, and then quickly slipped a camera from under the rug which was lying on the seat in front of him, and taking aim at the entrance shaft of a new ammunition store which had just been made for our Navy, he took a snapshot. Then hurriedly covering up the camera again he proceeded to strike matches and to light his cigarette. We followed close behind him till we came to where a policeman was regulating the traffic. I rode ahead and gave him his instructions so that the carriage was stopped and the man was asked to show his permit to take photographs. He had none. The camera was taken into custody and the name and address of the owner taken "with a view to further proceedings."

The Pluck of a Spy

Except in the case of the traitor spy, one does not quite understand why a spy should necessarily be treated worse than any other combatant, nor why his occupation should be looked upon as contemptible, for, whether in peace or war, his work is of a very dangerous kind. It is intensely exciting, and though in some cases it brings a big reward, the best spies are unpaid men who are doing it for the love of the thing, and as a really effective step to gaining something valuable for their country.

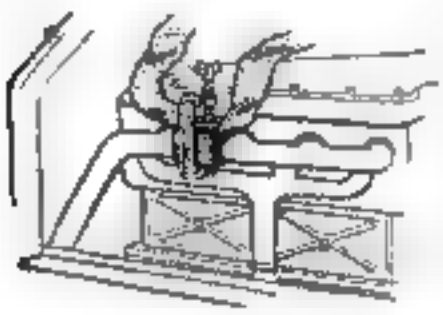
Many interesting schemes are resorted to in spying. Once I went "butterfly hunting" in Dalmatia. Carrying a sketch-book, a color-box and a butterfly net in my hand, I was above all suspicion to anyone who met me on the lonely mountain side, even in the neighborhood of the forts. I was hunting butterflies, and it was always a good introduction with which to go to anyone who was watching me with suspicion.

They did not look sufficiently closely into the sketches of butterflies to notice that the delicately drawn veins of the wings were exact representations, in plan, of their own fort, and that the spots on the wings denoted the number and position of guns and their different calibers.

The use of hair in disguising the face is perfectly useless unless the eyebrows are considerably changed. The brow and the back of the head are also extremely important factors in the art of disguise. The second picture shows the effect of "improving" the eyebrows of the face on the left, and also of raising the hair on the brow, while the third sketch shows what a difference the addition of a beard and extra hair on the back can make

The matter of disguise is obviously an important one. I was at one time watched by a detective who was one day a soldierly-looking fellow and the next an invalid with a patch over his eye. I could not believe it was the same man until I watched him from behind and saw him walking, when at once his individuality was apparent. It is wonderful what a difference is made by merely altering your hat and necktie. It is usual for a person addressing another to take note of his necktie, and probably of his hat, if of nothing else, and thus it is often useful to carry a necktie and a cap of totally different hue from that which you are wearing, ready to change immediately in order to escape recognition a few minutes later.

Vulcanizing Tires with Exhaust Heat



A DEVICE which enables the motorist to vulcanize tubes simply by using the heat developed at the exhaust tube of an automobile has been brought out by a Pennsylvania firm. The vulcanizer consists simply of a curved plate to fit over the exhaust manifold, a clamp for holding the inner tube in place, and a thermometer to indicate the temperature. By running the motor slowly the heat may be regulated so as to keep about 260 or 280 degrees, at which temperature the vulcanizing process will readily take place.

A Trouble-Proof Tire

PUNCTURE-PROOFING a tire from the inside is the latest idea of one well-known tire manufacturer. The "trouble-proof" tire, as this latest product is called, has a toughened chrome leather strip on the inside of the casing, where it touches the inner tube, and tires so treated have been run, according to the manufacturer's claim, for 12,000 miles without puncture. The idea is that the chrome leather strip will turn back the point of any kind of nail or spike, after this nail has penetrated the entire rubber casing itself.

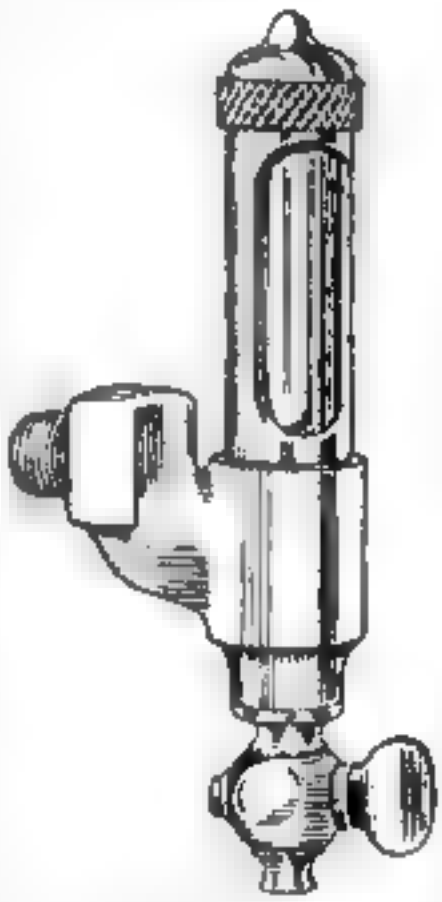
An Oil Cup for Auto Springs

A SIMPLE but effective oiling device for the leaves of springs on Ford cars is the Mosco oiler, shown in the accompanying drawing. It consists of a reservoir which is formed between the clamp and the side of the spring; felt washers are used to prevent the leakage of oil. The device is held in place by two set-screws.

Hot-Water Bottle Fits the Back

ORDINARY metal hot-water bottles have never been popular because of their inflexibility, but the shape of a new aluminum one does away with this inconvenience. It is oval and curved so that it fits the back or a cheek swollen with toothache equally well. For the cold-blooded person who cannot afford an electric bed pad, and for whom a rubber hot-water bottle loses its heat too quickly, the new bottle will be invaluable. Perhaps one of its best points is the fact that it does not wear out, or become leaky. Water for it can be heated right in the bottle by holding it over a lamp or stove. A thick eiderdown cover makes it soft and prevents its burning the aching or cold member to which it is applied.

An Anti-Clogging Oil-Gage



OIL-gages for use on automobiles have the disadvantage of catching all sediment in the lubricant. Clogging is the result. Practically all gages are constructed on the principle of the drain of a water-sink, with its sharply-curved piping. A manufacturer of gages has realized this inherent error in ordinary oil-gages and has brought out a new type which is intended to eliminate clogging It has a downward channel of large diameter, and is particularly adapted for Ford cars.

Why Weren't They Thought of Before?

Little Inventions to Make Life Easy

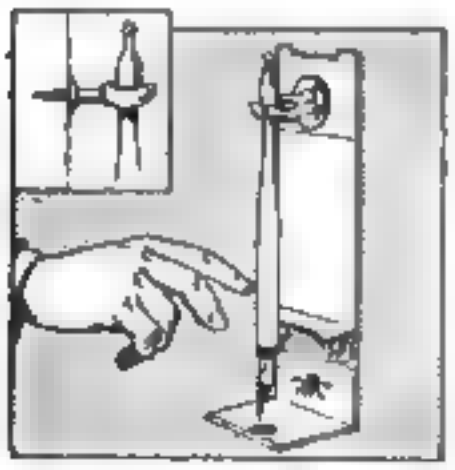
Light Your Umbrella if You Are Afraid to Go Home in the Dark

AN umbrella, made with an electric battery within its hollow handle, has lights affixed at each end of the stick and at the ends of the ribs. Push buttons in the handle make and break the circuit. The inventor has the idea that his umbrella will be of value in theaters and in dark streets and alleys.

Signaling to the Driver Behind You

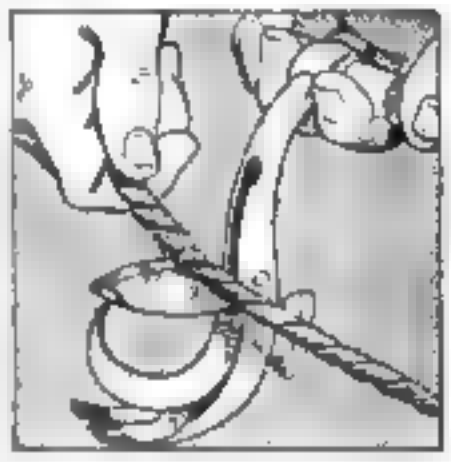
BY pressing an electric button on the steering wheel of an automobile, a red light is made to appear in a small box fastened on the rear mudguard, and a small semaphore arm is raised to indicate danger. When the button is pressed a second time, the semaphore drops and the red light changes to green.

Pen Rack Removes Ink from Nib



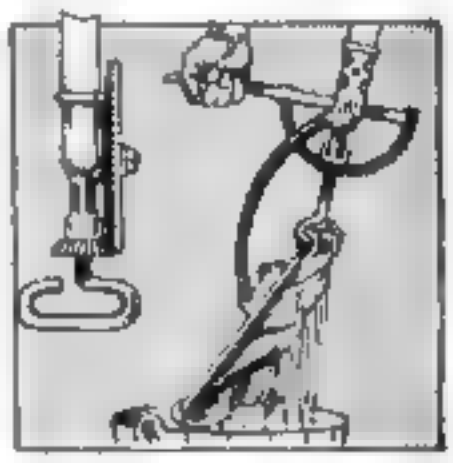
A PEN RACK to be fastened against the wall, has a pronged hook which holds the penholder in a vertical position, with the penpoint down. When the penholder is hung up and allowed to swing back it is suddenly arrested by a ledge and the ink is spattered against the blotting paper.

A Freight Hook of Many Uses



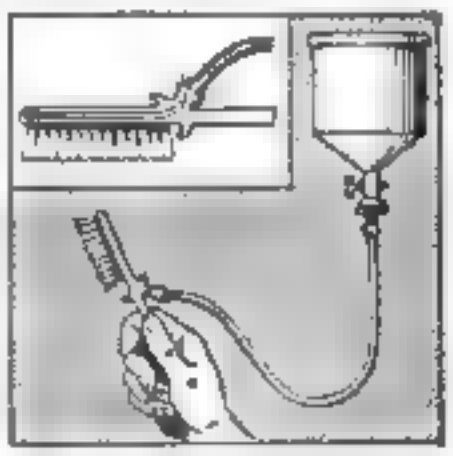
SEVERAL improvements are made over the familiar hook commonly used by teamsters and freight handlers. At the lower part of the hook, the shank becomes separated and is curved upward to form a claw, very useful for pulling nails. The fulcrum of the claw is shaped like a hammer head, and may be used for driving nails. Hinged to and countersunk in the shank is a blade which serves for cutting and as a keeper for the hook.

Do Not Wring Your Mop by Hand



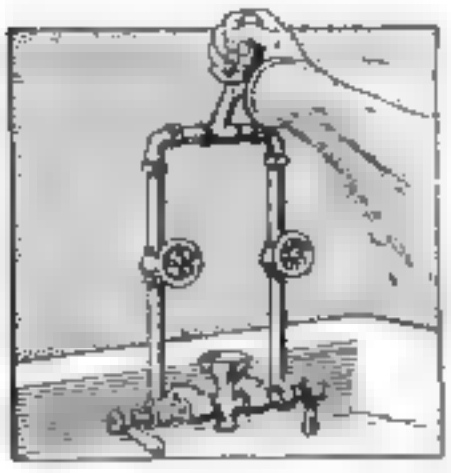
A GEAR, actuated by a handle, turns a hook to which is attached one end of a mop. At the same time, the pressure frame is moved upwards by a set of gears, also actuated by the movement of the handle. Thus, when the handle is moved, the mop cloth is tightly stretched by the shifting of the presser frame, and the small loop is turned until the mop is wrung out.

A Fountain Tooth Brush



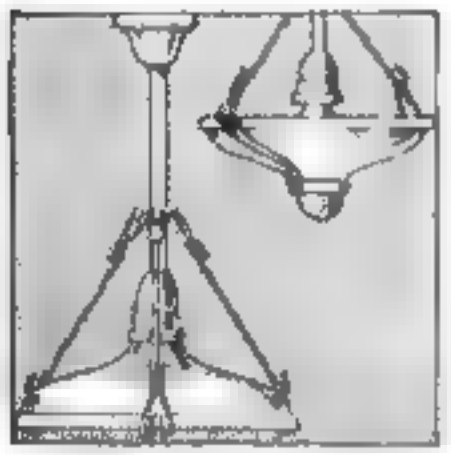
THIS toothbrush is equipped with a hollow head and passages leading from this cavity within the brush to the bristles. Near the handle is attached a tube which conveys a medicated solution from a tank suspended above directly to the interior of the brush.

Adjusting a Shower Spray's Angle



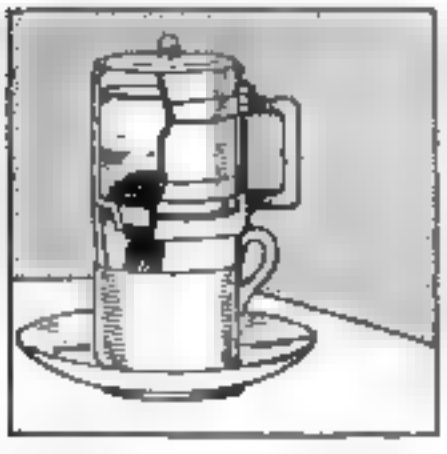
A SHOWER-BATH attachment intended to control the angle of discharge is made by attaching two upright pipes to the discharge-taps of the supply-pipes. At the desired height elbows are affixed to the pipes to join them in the center. At this point a swiveled T-pipe is connected to both ends of the pipes, so that the angle of the upright portion of the T may be changed at will. To the upper end of the T-section are added the adjustable shower attachment and a handle.

Both Direct and Indirect Lighting



A REFLECTOR for an electric light is made so that the fixture may be used for either direct or indirect lighting. The reflector is shaped like a canopy, and is held in either position by wire or chain crows' feet leading from the main support. The lamp-receiving socket is enclosed in a standard, which may be coupled directly to the support when the fixture is used for direct lighting. When indirect lighting is desired, the lamp socket is covered by a metal cap.

A Coffee Percolator In Your Cup

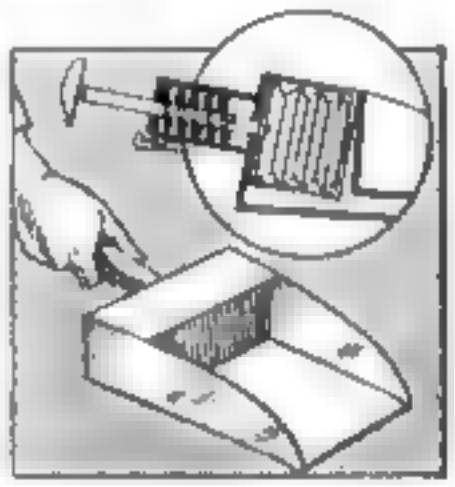


A SMALL percolator with which a guest at a restaurant may make a cup of coffee to suit his own taste holds an ordinary cupful of liquid. In the container, which is clamped upon the cup, is placed ground coffee and hot water and clear coffee drips through the strainer into the cup. When all the water has dripped out, the container is set aside.

Blow Up Your Shoes with Air

IN order to keep expensive and delicate shoes in proper condition when they are not being worn, the pneumatic shoe-tree exerts an even pressure on all parts of the fabric. A metal form partially surrounds a flexible sack which, when filled with air, takes the place of the old fashioned wooden tree. The sack naturally follows the lines of the shoe, so the leather is not forced out of shape.

A Vacuum Cleaner Dust-pan

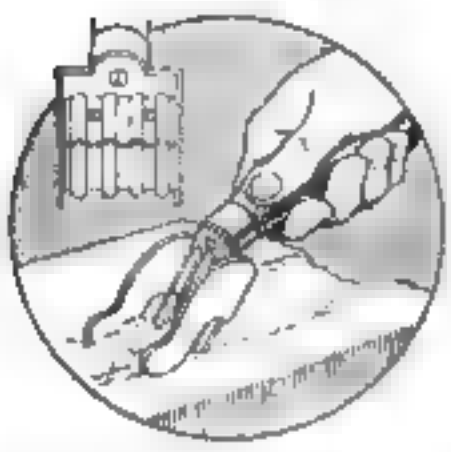


A DUST-PAN is made with a false bottom and with a chamber in the large end. In this chamber is a bellows, actuated by a plunger in the handle. The passageway leading from the bellows through the false bottom ends in a lip just below the normal edge of the dust-pan. To remove the last dirt from the floor, the slot is placed over it, and by means of the bellows the dust is quickly sucked in.

A Spring Cover for Milk Bottles

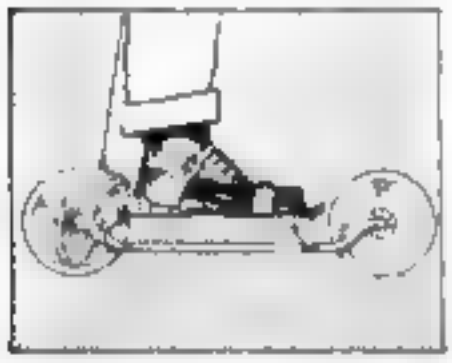
AN attachment made of spring steel which consists of a stout handle and a lip and cover for pouring out the contents of a milk bottle is held firmly to the bottle by the tension of the spring steel. This exerts an upward pressure on two grips at the base of the bottle, and a downward pressure on the ring which forms the pouring lip at the top. A cover is hinged to the ring at the top, so that it opens by a pressure of the thumb.

This Ice-Shaver Saves Muscle



A SHEET metal blade provided with a corrugated cutting edge is secured to two side-arms, which act as a guide when the device is in operation. The entire device is fitted to a convenient handle. In use the cutting edge is pressed to the ice and is guided by the metal side-arms.

A Foot-Propelled Motor Skate

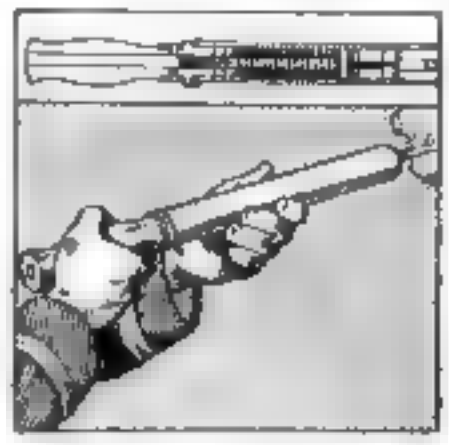


THE accompanying sketch shows a novel form of skate in which the power of locomotion is supplied by the feet of the skater. The foot-piece is mounted between the two wheels, slightly lower than their centers. Within the frame proper is concealed a strong steel revolving screw, which communicates with the rear wheel by means of the ratchet gearing shown in the diagram. To set the skates in motion the skater applies the power to the screw by pressing down on the foot-plate, which is connected with the screw by the crank in front of the toe. Thus the drive-wheel, which is the rear wheel of the skate, is set in motion. The model shown is provided with two wheels; but this same mechanism may be applied to the four-wheeled skate with equal facility.

A Tooth-Brush Which Fits Your Finger

A CASING composed of all-absorbent fabric, and fitted on one side with a bead or flange, is held on one finger while cleaning the teeth. To the end of the device a string is fastened, which may be used to hold the case on the finger while in use, or may be used to clean between the teeth.

A Policeman's Club Which Is Also a Gun



A POLICEMAN'S club is provided with an internal mechanism whereby the club may be converted into a firearm, to discharge one bullet. By means of a system of springs, the firing-pin is held retracted until the handle of the club is unscrewed for a short distance. This action releases a safety catch, and the cartridge is ready to fire. In discharging, the handle is pulled back and released.

Chalking Billiard Cues Mechanically

A CYLINDRICAL holder for chalk is cast integrally with a short rod, in which is a spiral slot. The entire device fits over a rod projecting down from the ceiling. On this rod is a pin, which fits into the spiral groove on the chalk holder. When the cue is placed in the funnel-shaped opening of the holder, an upward push causes the device to revolve until the pin has reached the end of the spiral groove.

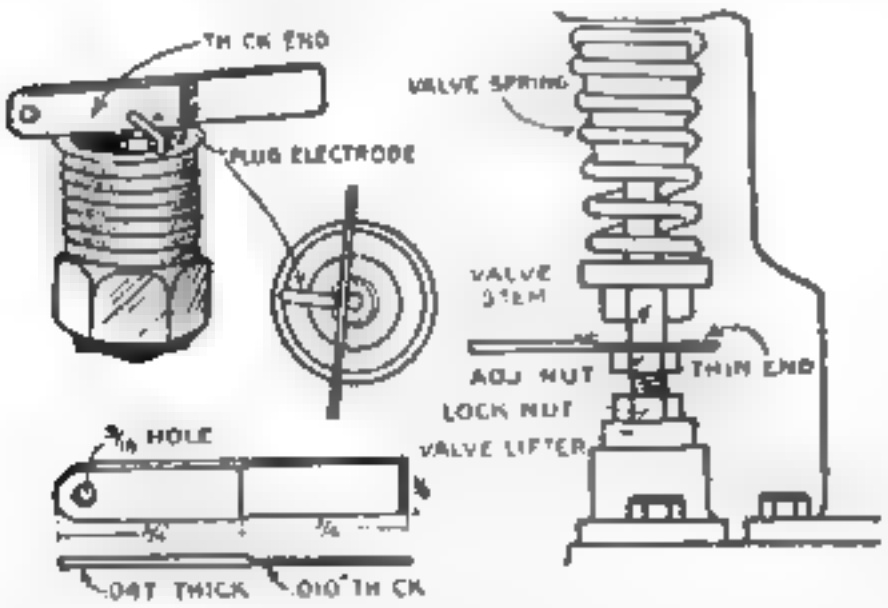
Parting Thick Tresses

A BOHEMIAN inventor has patented a comb intended for owners of thick hair which refuses to stay parted. As shown in the illustration, the device consists of two combs which are secured to an elastic band. The combs are inserted in the hair at the point where the part is desired, and then drawn apart. At the same time, the band is being stretched over the head and holds the hair down flat. The combs can then be released from the head, while the band is retained in position.

For Practical Workers

A Useful Gage for Motorists

A VERY simple but useful attachment for the automobilist's key-ring is shown in the accompanying illustration. It can be made of spring steel



The little piece of steel illustrated can be used in the ways shown and in many others

or hard brass, steel being preferred, however, since it can be hardened and tempered. It is made from a piece of stock about .050-in. thick, 1½-ins. long and ⅜-in. wide. Before hardening, a $\frac{5}{16}$-inch hole is drilled in the end and the corners rounded off to make it easily inserted on a key-ring. The piece is then ground down to about .046 in. to .047-in. thick for about half its length, and to about .010-in. thick for the remainder.

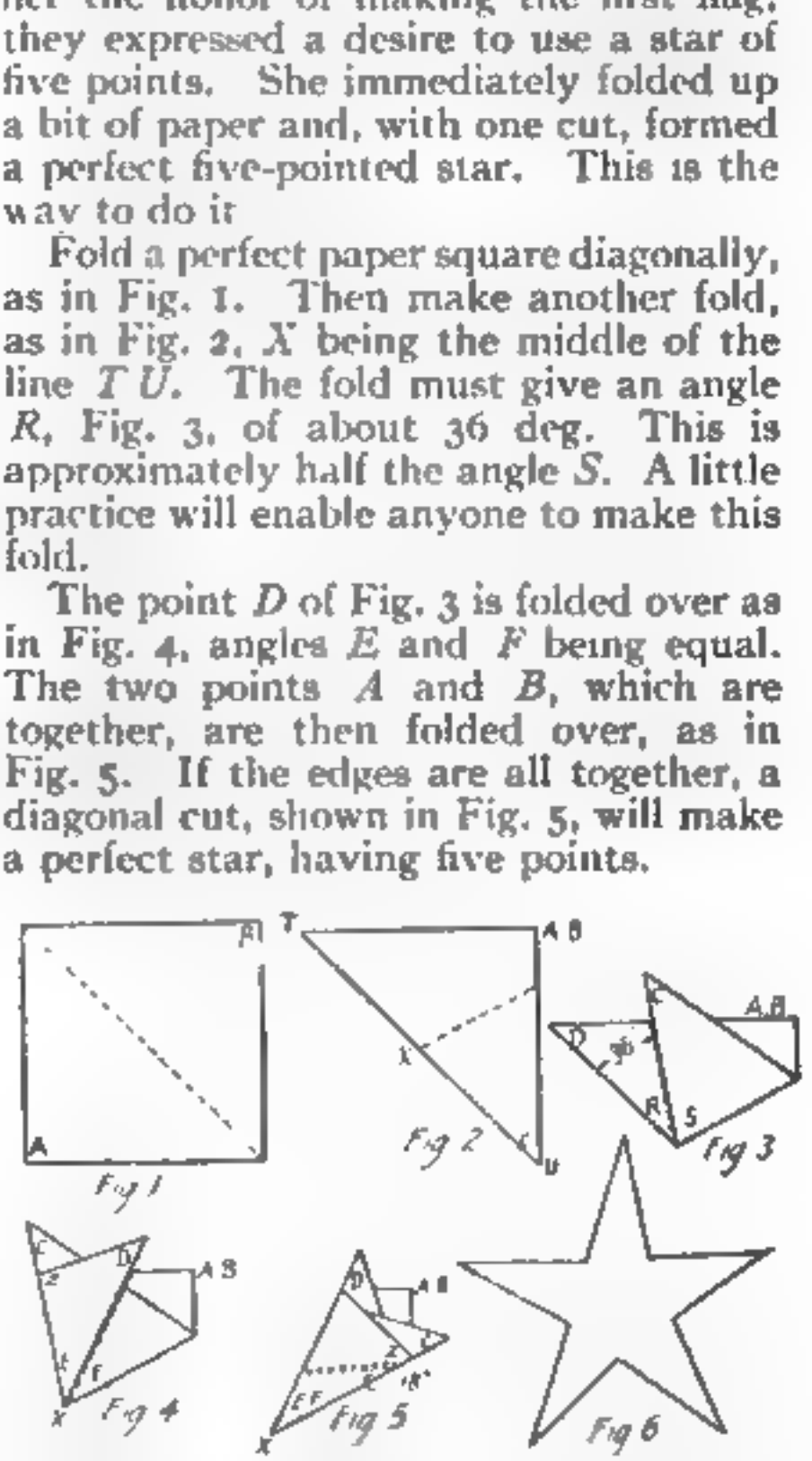
The thick end will be found valuable for setting the gap between the electrodes of the ignition spark-plug; the thin end will be useful when adjusting the clearance between the valve stems and adjusting nuts on valve-lift plungers. The gage can be easily made and will be found very useful whenever such a tool is needed.—VICTOR PAGE.

How Betsy Ross Made a Five-pointed Star with One Cut

WHEN George Washington and two other Revolutionary leaders called on Betsy Ross to bestow upon her the honor of making the first flag, they expressed a desire to use a star of five points. She immediately folded up a bit of paper and, with one cut, formed a perfect five-pointed star. This is the way to do it

Fold a perfect paper square diagonally, as in Fig. 1. Then make another fold, as in Fig. 2, X being the middle of the line $T\,U$. The fold must give an angle R, Fig. 3, of about 36 deg. This is approximately half the angle S. A little practice will enable anyone to make this fold.

The point D of Fig. 3 is folded over as in Fig. 4, angles E and F being equal. The two points A and B, which are together, are then folded over, as in Fig. 5. If the edges are all together, a diagonal cut, shown in Fig. 5, will make a perfect star, having five points.



Making a Five-pointed Star with One Cut

Fig. 1 Fold in square of paper Fig 2 X, middle of TU Fig 3. Angle R is half angle S Fig 4 Angle E is equal to angle F Fig 5. Ready to cut. Fig 6. Completed star

Making and Using a Small Still

AMATEUR chemists and photographers as well as other experimenters often find themselves in need of pure or distilled water. This still will prove a help and is an interesting apparatus to make. It is easily operated and will distill a comparatively large quantity of liquid.

The principle of distillation is the mere raising of a liquid to its vaporizing point and the collecting and condensing of its vapor. The most important part of the still is the condenser, which is shown in the detailed diagram. It consists of a large glass tube about 1¼ ins. in diameter and about 12 ins. long. Each end is sealed tightly with a good sound cork stopper.

Three tubes known as the condensing coils are about ¼ in. in diameter and 16 ins. long, and are passed through the

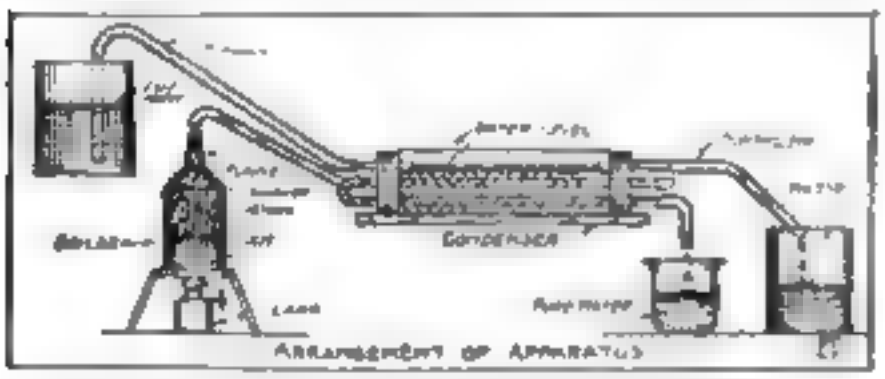
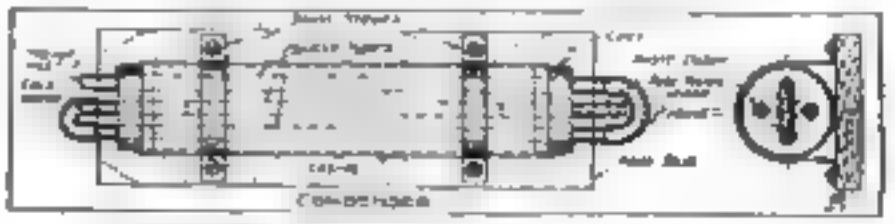


Diagram of the arrangement of apparatus for a small still

stoppers and glass casing. Two short lengths of tubing are placed in the corks to allow the cooling water to enter the casing and to provide an overflow outlet. The condenser ends should be painted with shellac or dipped into molten paraffin wax to seal any leaks. Connect the three coil tubes with rubber tubing, as shown, to make one continuous circuit, and to allow the vapor to enter one end and pass through the casing three different times before the condensed liquid emerges. Mount the casing upon a wooden base with two brass straps.

The diagrammatic arrangement of the apparatus shows the system of operating. The boiler is easily made from a can and small funnel as shown. Solder the funnel carefully to the top of the can. Fill the boiler by submerging in the liquid. Use a Bunsen burner or alcohol lamp for vaporizing the contents. Connect the boiler to the inlet of condenser by means of rubber tubing. A vessel of cold water is used to cool the condenser, the water being siphoned to the water inlet on the condenser through tubing. Make certain that the coil tubes are entirely



Detailed diagram of the condenser

covered with the cooling water to insure perfect condensation. Allow the waste water to drain off and collect the distillate in a clean vessel.

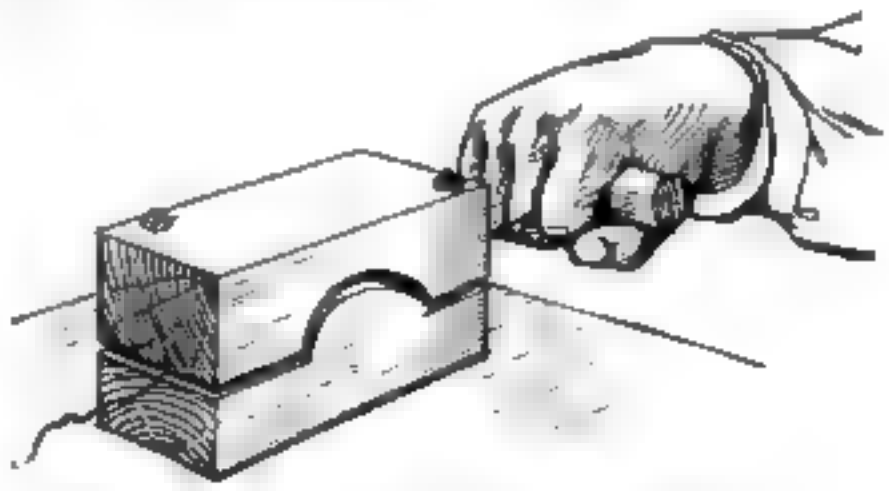
Remember that distillation is based upon the principle that the boiling points of different liquids differ. With this in mind many interesting experiments can be made with the apparatus described. Any desired liquid may be removed from a mixture of various liquids by keeping the boiling point of the mixture the same as that of the desired substance.

The boiling points of some common liquids at sea level are as follows:

Water 212° Fahr.
Alcohol 173° Fahr.
Ammonia 140° Fahr.
Chloroform 140° Fahr.
Saturated Salt Sol. 226° Fahr.
Turpentine 315° Fahr.
Sulphuric Acid 590° Fahr.
Ether 100° Fahr.—B. F. Dashiell.

Straightening Kinked Wire

KINKED wire can be straightened satisfactorily with two blocks of wood, cut and fitted as shown in the accompanying drawing, and bolted together loosely. The wire is passed between them, wrapped around a short strip of hard wood and pulled with a firm, even pressure.



Crooked wires can be straightened out by merely running them between these two blocks of wood

How to Construct a Simple Cyclecar Starter

A RELIABLE home-made starter for cyclecars, or other light cars, capable of being operated from the seat, can be made in the following manner:

Drill a ½-inch hole in the end of a strong piece of wood, 1 in. by 1½ ins. by 3 ft., shown at *A* Fig. 1. Make a bearing by fitting in a piece of steel or brass tubing. Make another hole *B* ⅜ in. in diameter, about 1 ft. from the first one;

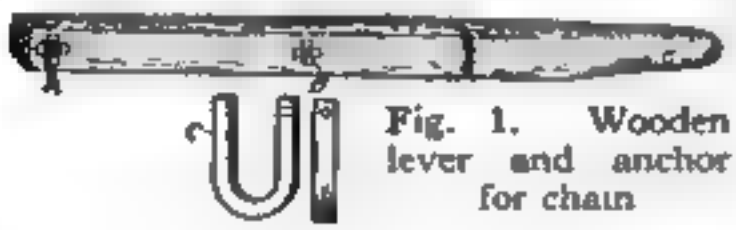


Fig. 1. Wooden lever and anchor for chain

and fit in a bearing. Bend a piece of steel, ½ in. by ½ in., into a U-shaped form as at *C*. After drilling holes in the ends, connect this piece to *B* by means of a bolt

Saw off the crank of the car a few inches from the bearing. It must then be tapered and a 14-tooth motorcycle sprocket keyed and bolted on, as shown in Fig. 2. Place a spring on the inside of the casing to bear against the engaging ratchet, thus forcing it to catch when the sprocket is turned, Fig. 2. To throw this ratchet out after the engine has started, a small wire or cable is run from the seat to a bell-crank, and this forces the sprocket and ratchet out. The long lever-arm is now fastened by the bearing *A* at some convenient place on the frame, allowing for a free movement back and forth. The piece *C* is then bolted on at *B*, Fig. 1. A wire rod, attached to *C* is fastened to a chain, which passes over the sprocket and connects with a coiled spring. When the arm is pulled forward, this spring draws it back. The relation of parts is shown in Fig. 4.

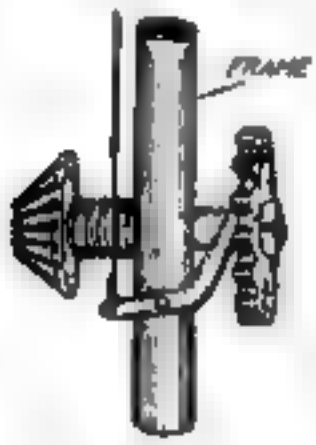


Fig. 2. Motorcycle sprocket on crankshaft

Fig. 3. Fastening and attachment of wooden lever

To operate, the wire lever fastened to the seat is first released, allowing the ratchet to spring into mesh. The lever-arm is then pulled up with a jerk; this spins the engine over from one to two turns, depending upon the size of the sprocket and the distance of *B* from *A*. When the motor starts, the wire from the seat is drawn back and the ratchet is pulled out of gear. In case the motor kicks, the lever simply flies out of the hand and falls down on a spring cushion or on the wire rod. No damage is ever done by a kick, since, by the time the engine has turned over once, most of its energy is lost. The main advantage over a crank lies in the increased leverage derived, and also in the greater number of turns which can be given the engine. With this starter, the greatest amount of force is delivered just at the point when

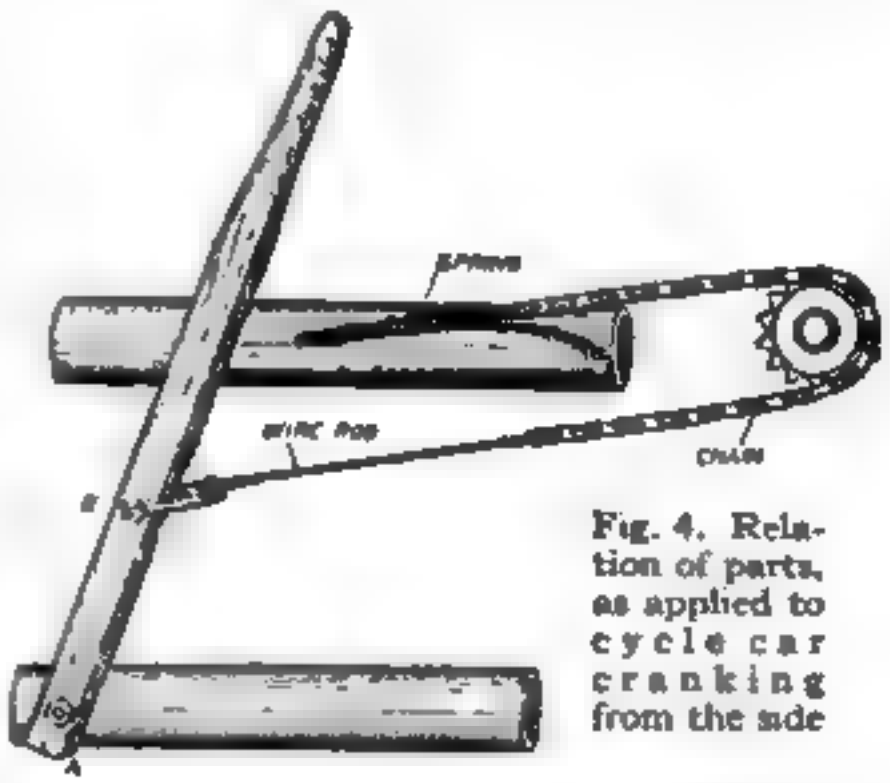


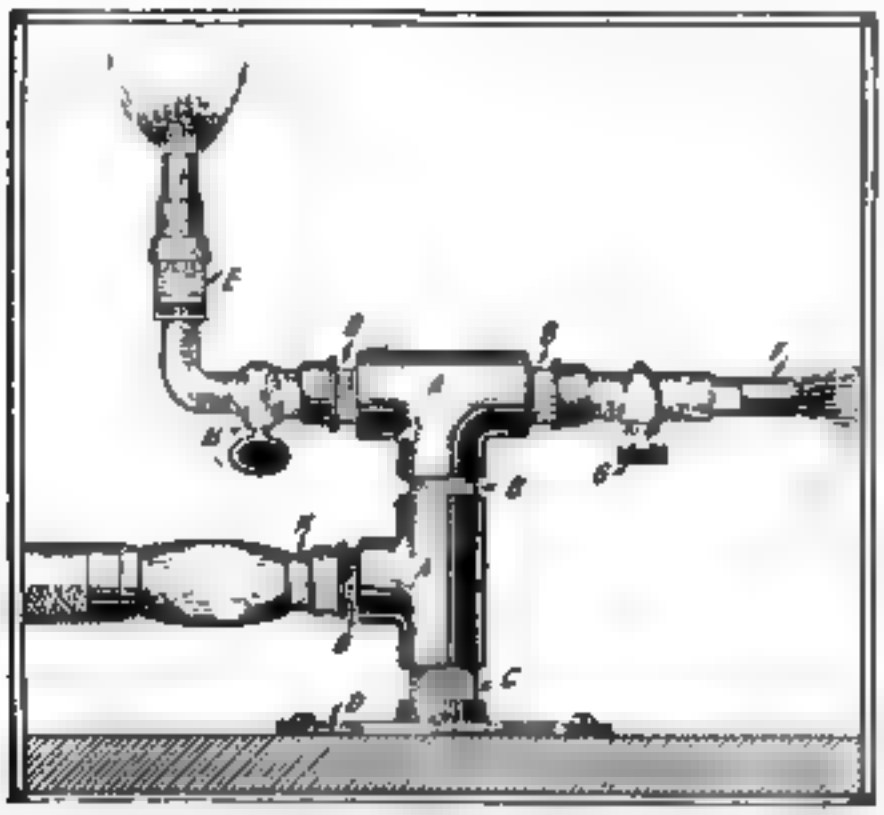
Fig. 4. Relation of parts, as applied to cycle car cranking from the side

the engine has its highest compression, which makes it desirable for magneto ignition. There is positively no danger of getting a broken arm with this starter.

The diagrams are for a cyclecar, cranked from the side. By means of a series of pulleys and wire cable, the same principle applies where the engine is cranked in front. —N. S. McEwen.

Removing Tires with a Clothes-Pin

SINGLE-CLINCH bicycle-tires may be quickly removed by means of an ordinary clothes-pin. Separate the prongs of the clothes-pin until it splits. The larger piece may be used in prying the bead of the tire away from the hooked edge of the rim, and also for lifting it over the edge. Use the other prong to prevent slipping back into the curve of the rim.—G. M. Morrison.



Arrangement of parts and connections for Bunsen burner and blow-torch

Bunsen Burner and Blow-Torch Combined

A COMBINATION Bunsen burner and blow-torch can be made from ⅜-inch gas fittings. The cost should not exceed $1.

The following material is needed:

Two tees, *A*
Five 1 inch nipples, B, C.
One floor plate, *D*
One air-mixer from an inverted gas burner, *E*.
One air-mixer from an upright gas burner, *F*.
One straight valve, *G*.
One "L" valve, *H*.
One valveless hose connection, *K*.

The fittings should be assembled as shown.

By careful adjustment of the air-mixer, *F*, an intensely hot blue flame twelve to eighteen inches long can be secured. By regulating the mixer, *E*, the usual Bunsen flame may be obtained.
—A. C. Fisher and J. B. Whittaker.

Brass Tube Cleans File Teeth

TEETH of a file clogged with lead or other metals can be cleaned with a short length of brass tubing. The file should be held on edge and the tubing forced along the teeth. Wedges will be formed at the end of the tubing, which will force out the metal which has formed between the file teeth and thoroughly clean the file.—E. B. Williams.

Cutting Glass Bottles and Tubes with Oil

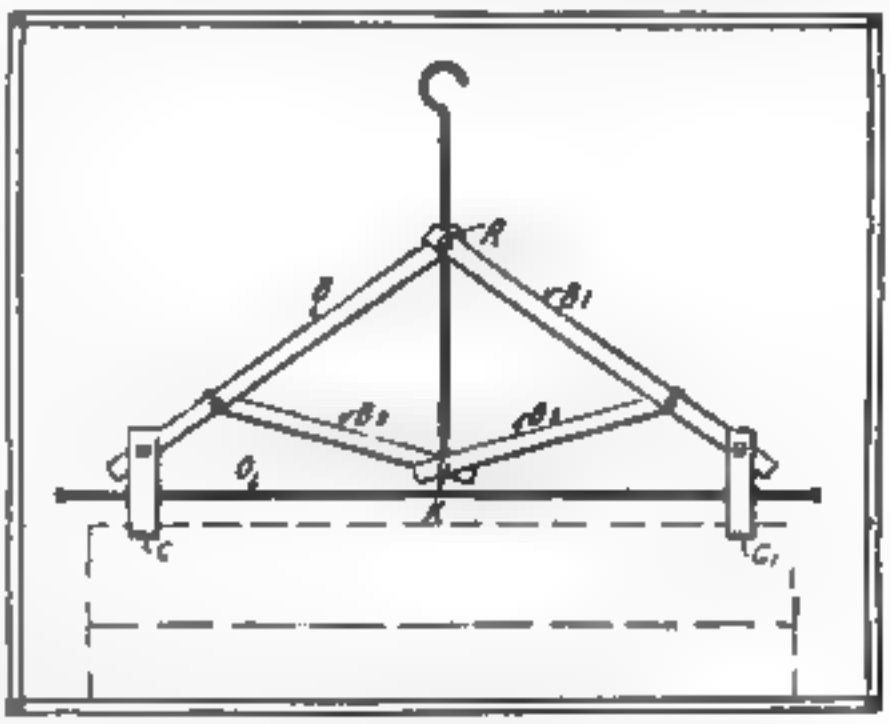
TO cut a glass bottle or tube, fill with lubricating oil to the level you wish the vessel to be cut. Then heat an iron rod to the point of redness and slowly dip it in the oil. When the oil gets hot, the vessel will crack round the top of the oil, making a clean, even break that can be dressed off on a grindstone.—A. E. Smith.

A Coarse File for Soft Metals

LEAD or other soft metals can be filed with an ordinary flat file which is annealed and cut along one edge with sharp angular teeth. Afterwards, the file should be rehardened.
—E. B. Williams.

A Trousers-Hanger

THE pieces *B*, *B'*, *B*² and *B*³ are flat strips of metal riveted to make flexible joints. The rivet *R* is made with a hole in its head large enough for the rod to slide through and connect to the rivet *K*, while *C* and *C*¹ are clips to

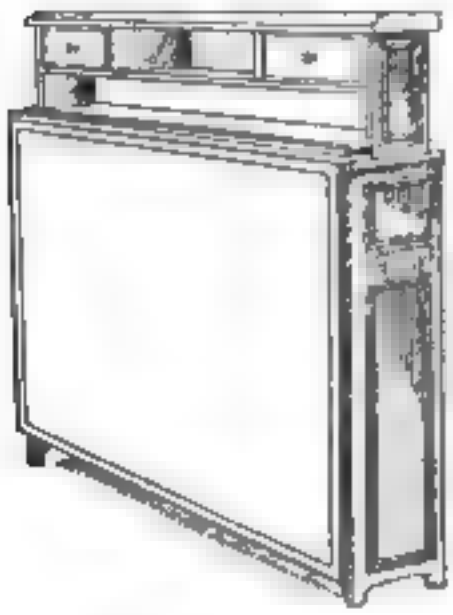


This trousers-hanger is easily made and is more efficient than those which can be bought at most stores

hold the trousers, and are connected to *B* and *B*¹ by flexible joints. The clips slide on the rod *O*. The weight of the trousers will be exerted at the point *K*, thus pushing out the strips *B* and *B*² and stretching the trousers. This appliance is not only light and non-breakable, but it is also easy to make. Every man should welcome it.—Leo M. Lafane.

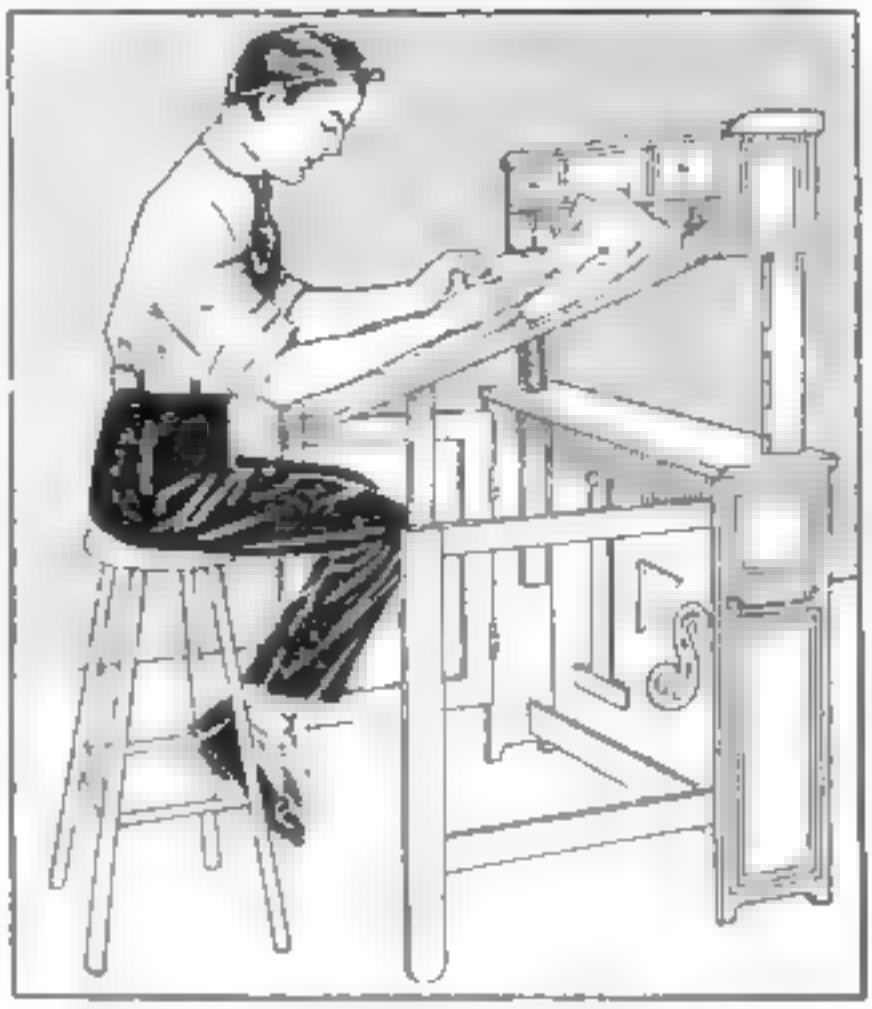
A Piece of Furniture with Many Uses

LACK of space in business offices or dwellings makes it difficult to use many pieces of furniture, such, for instance, as a writing desk, drawing table, cupboard or blackboard. In some cases the professional requirements of engineers and draftsmen make a number of pieces of furniture necessary, but these take up much space, and may even require several rooms to contain them. A great economy of space is effected in the combination illustrated. It can be converted into a desk either horizontal or inclined, for the transaction of ordinary business; a drawing table whose height and slant can be regulated for a standing person; a blackboard of good height; and lastly, a closet. The whole is not more than ten inches thick when folded.



The desk closed

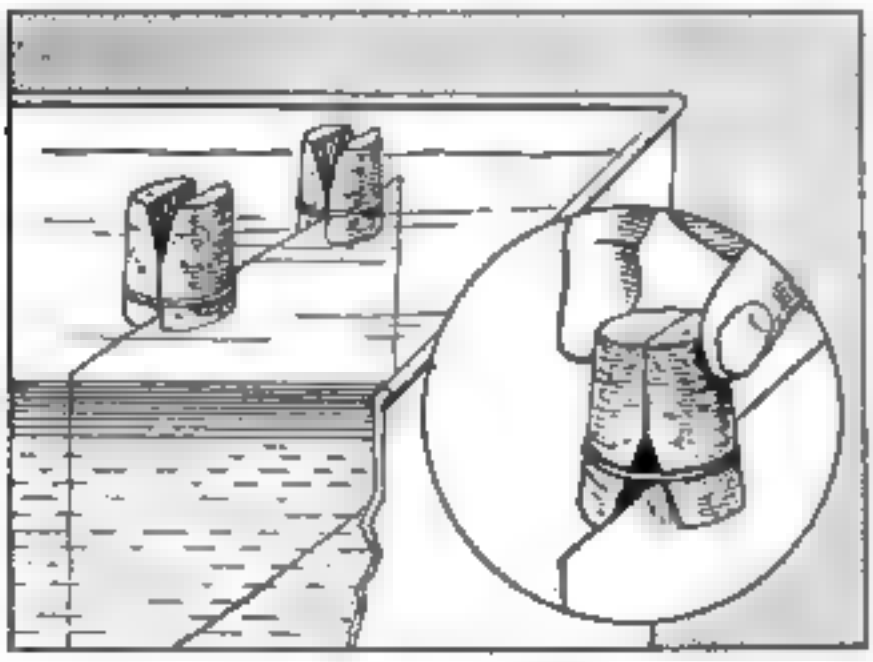
The main box part, which serves to hold drawing instruments and the like, is provided with a top portion containing drawers, adjustable at various heights. This holds the large drawing board hinged to it, the base of the board resting on a pair of legs with adjustable top. The legs can be folded back into the main box when the drawing board is let down. By turning up the drawing board so that it mounts straight in the air and exposes the under side, we have a blackboard, located at a convenient height.



The desk extended and raised serves as a fine drawing board

Washing Blueprints and Bromide Enlargements

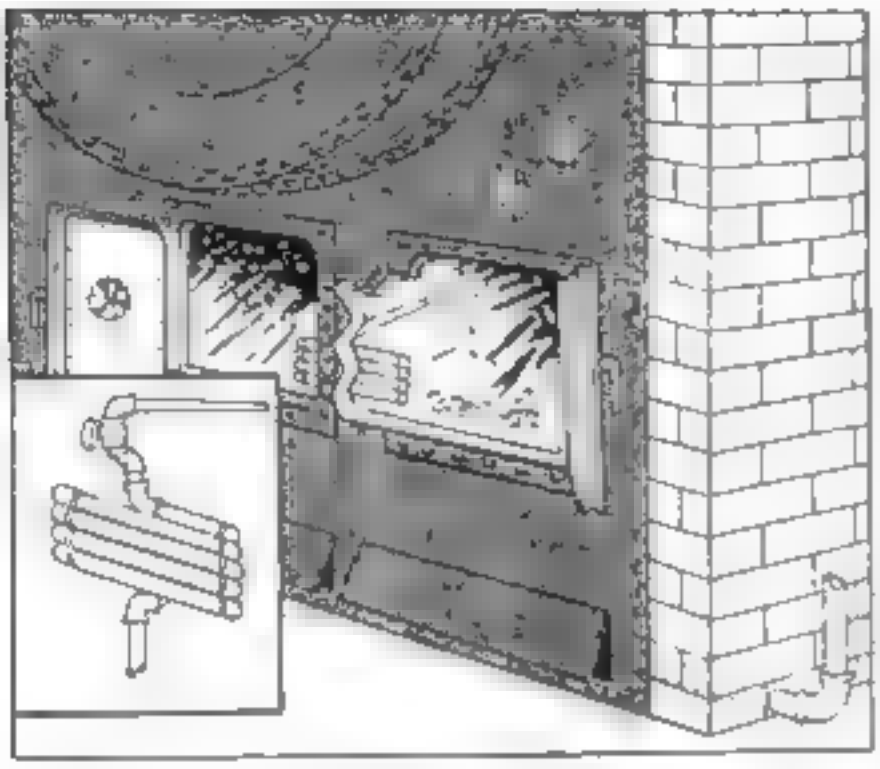
THE difficulty of washing blueprints and bromide enlargements (especially of the larger sizes) often makes one hesitate to attempt much work of this kind.



Cork floats easily attached to large sheets make the washing of bromide enlargements an easy task

The difficulty of washing large enlargements and blueprints can readily be overcome in the following manner:

Procure some large corks, and in each cut a groove around the cork near the smaller end, to serve as a retainer for a rubber band. Then cut the cork lengthwise through the center, and cut a wedge-shaped piece from the top, or widest part of the cork, as shown in the illustration. Place a rubber band in the groove to form a sort of clamp. Attach several of these cork floats to the edges of the prints to be washed, and place them in the washing receptacle, which must be deep enough to enable the prints to hang vertically. As hypo and blueprint chemicals always sink, the prints are thoroughly washed in the shortest possible time.—C. I. Reid.



A superheating coil for oil-burning furnaces gives an even pressure and complete combustion

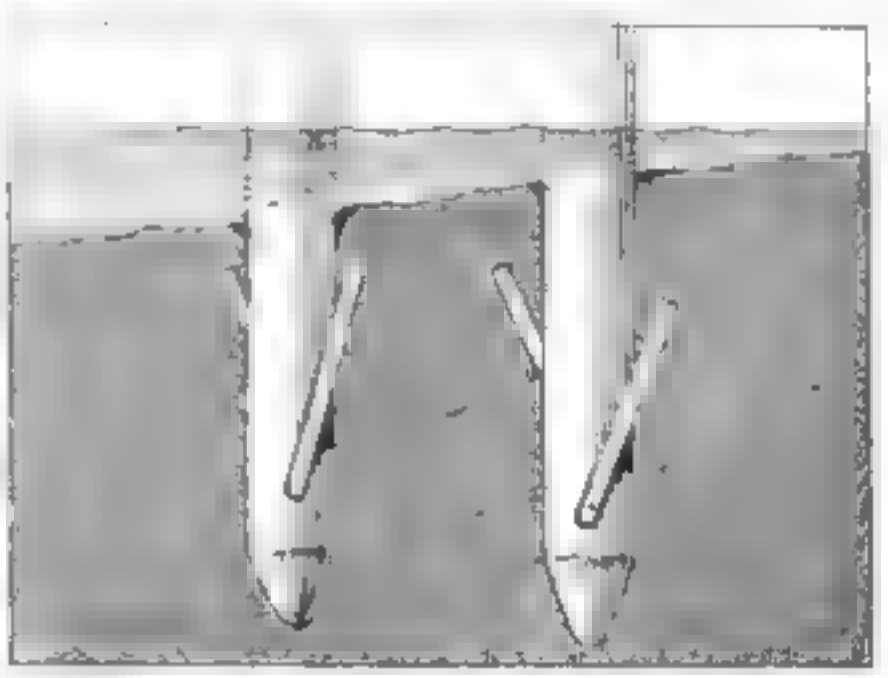
Save Fuel for Oil-Burners

IF the feed-pipe of an oil-burner is lengthened and bent into several convolutions which are placed directly beneath the burner, the oil is thinned and gas is formed, with the result that an even pressure is gained and more heat per unit of oil is obtained. In many cases it will be found that the increased pressure will be sufficient to justify doing away with the pressure pump ordinarily used. Care must be taken in installing superheating coils of this type; otherwise explosions and disastrous fires may result.

A Speedometer Light for Ford Cars

THERE are numerous 6-volt speedometer lights on the market, but it is very hard to obtain a bulb that will not burn out when used with the current direct from the Ford magneto, the voltage of which is about 12. If suitable resistance is placed in series with a 6-volt light to cut down the voltage to 6 volts, the standard 6-volt light will work very well on a Ford. Twenty-five feet of No. 26 B. & S. gage German silver wire is the proper amount. It may be wound upon a piece of porcelain tubing or any other non-conductor. After it is wound it should be thoroughly wrapped with friction tape to protect it. To install it, one wire from the resistance coil can be connected to the binding post where the wire from the magneto binding post connects on to the binding post of the coil box underneath the hood.

The resistance can be fastened to the dash underneath the hood by taking several turns of tape around the coil and driving a tack in each end of the tape. This will hold it in place very satisfactorily. The other wire from the coil should be run to the other side of the car, being careful not to get it grounded to any metal parts of the car. It should then pass through a hole drilled through the dash at the exact place where you want the light located, through the light, and then should be grounded to the iron frame of the machine at any convenient place. It is best to buy a speedometer light with a pull-chain switch socket, but if you cannot obtain this kind conveniently you will have to get a small dash switch of some kind and place it in circuit with your light. This light, if carefully installed, is very satisfactory. The author has one on his car and knows of two others who have used the same idea and are very well pleased with the results.—IVAN M. WELLS.



Simple barbs of wood attached to piles will prevent them from working up when driven in quicksand

Driving Piles Into Quicksand

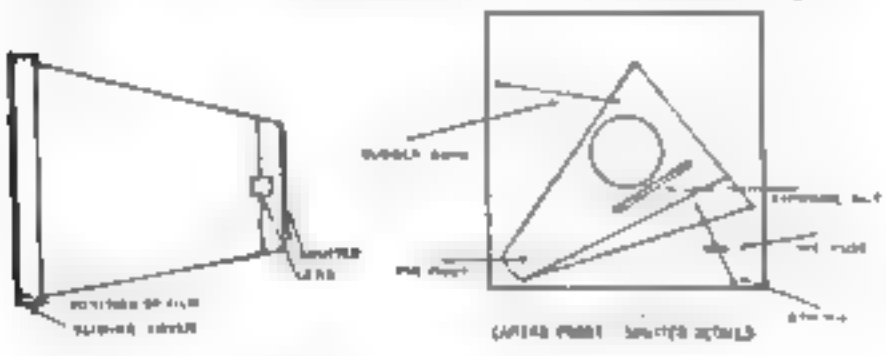
WHEN driving piles in quicksand, under water, the piles have a tendency to rise from 1′ to 3′, unless the hammer is left set on them for several hours. To avoid this waste of time, cut up some tough saplings of about 2″ diameter, into lengths of about 2′, and spike them to the piles like barbs, as shown in the illustration. The results are very satisfactory.—J. L. BAYLEY.

Making a Kite-Camera

FEW of us can have the experience, at the present time, of a ride in an aeroplane, but it is quite possible to see how our surroundings look from a high viewpoint, by taking pictures from a kite. It would take a very large kite, indeed, to carry some forms of ready-made camera, but it is easily possible to make a camera light enough so that it can be attached to any good kite and still be capable of making perfect pictures.

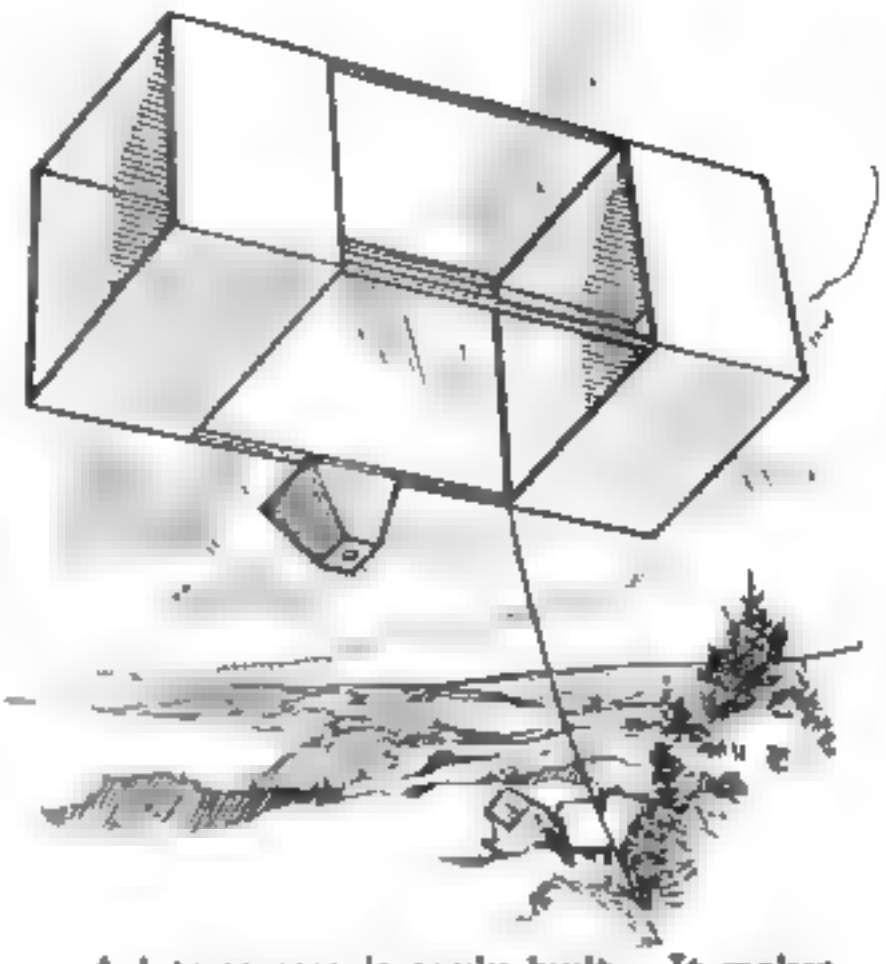
The lens is probably the most important part of a camera, and for a kite-camera nothing would serve the purpose better than a single achromatic lens, such as is fitted to small box cameras. Such a lens is light in weight and capable of making very good pictures. The lens can be bought very reasonably, or one can be taken from some other camera. The lens should be obtained first of all, before starting the construction of the camera, as the dimensions of the camera box must be in proportion to the focal length of the lens. A lens of two or three inches equivalent focus is satisfactory. The equivalent focus of the lens can be determined by focusing the sun on a piece of paper. The distance of the lens from the paper when the sun is focused to a burning spot is the distance at which the lens is to be placed from the plate or film.

For the purpose of kite photography a camera taking pictures two inches square is big enough. If larger pictures are desired they can be subsequently enlarged. The construction of the shutter and camera box is explained by the diagrams.



The camera used should be built of the lightest materials and every allowance made for air resistance

The box of the camera is made cone-shaped in order to reduce the weight and air resistance. The sides of the



A kite-camera is easily built. It makes bird's-eye photographs

camera are made of light but stiff cardboard, glued together with a strong adhesive. The back of the camera is made in the form of a tight-fitting cover, also made of cardboard, and the inside measurements should be the same as the pictures to be taken. The lens is fitted to an additional partition of heavy cardboard fitted inside of the cone, at the same distance from the back of the camera as the focal length of the lens. By sliding the lens back and forth slightly in its tube, a sharp focus can be obtained on distant objects, and the lens is then firmly fixed in position.

The front of the camera, also of cardboard, is provided with a circular opening which must be large enough so as not to obstruct the view of the lens. On to the front is fitted the shutter, which consists of a sheet of cardboard blackened on the inner side, and cut in a triangle shape. Into the shutter, near the center, is cut a slit, which serves to make the exposure, by admitting light through the lens when it moves across the aperture. The size or width of the slit regulates the time of exposure, and a few trials should be made in order to obtain the most suitable width for the speed of the lens and film to be used. In general, the slit can be as large as it is possible to make it without admitting light to the film while the shutter is

closed in either direction, right or left.

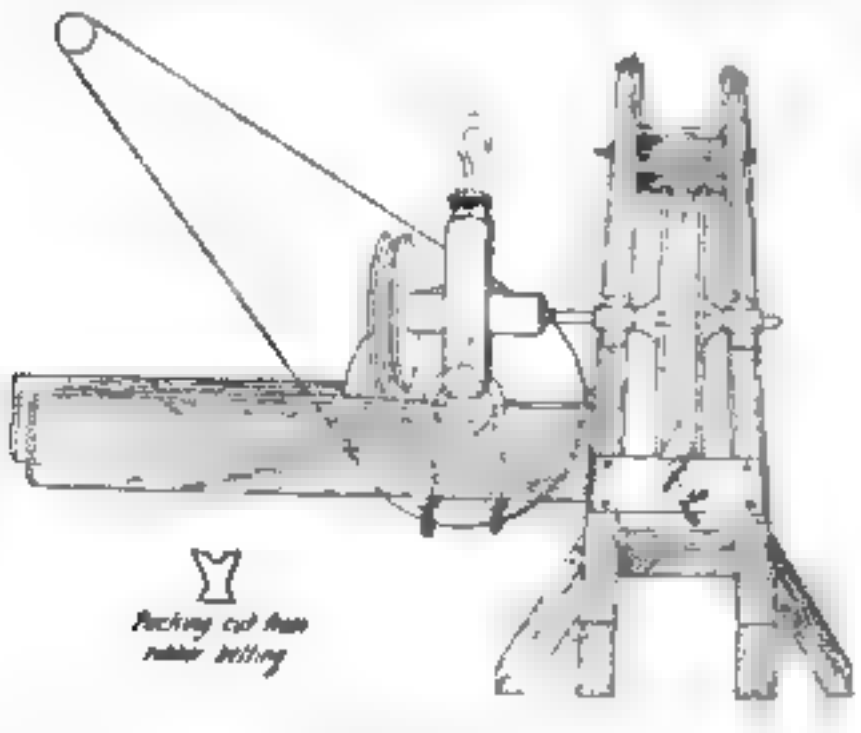
The shutter is pivoted at the lower end, and the motive power is supplied by a rubber band which draws the shutter to the left when it is released to make the exposure. The exposure is made by means of a time-fuse attached to a string which holds the shutter to the right, against the pull of the rubber band, until the fuse has been consumed, when the string is burned off and the shutter released. At that moment the picture is made. The shutter must fit tightly and must admit no light to the inside of the camera, except through the exposure slit.

When the camera has thus been completed it should be covered on the outside with black needle paper, to make it absolutely light-tight, and the inside of the box should be blackened with a pure black ink.

The proper length of fuse to use, so as to release the shutter after the kite has attained the maximum height, can be determined by making a trial flight with the camera attached to the kite, timing with a measured length of burning fuse. A length of fuse corresponding with the length burned until the kite reaches the greatest height, is attached to the string, and the camera is now ready to be loaded with film, which is done in a dark room by the light of a ruby lamp. Films of the correct size can be obtained from a film pack, or a roll film can be cut up into pieces of the correct size. The film is laid into the back or cover of the camera with the dull or emulsion side towards the lens, and the cover placed on the camera

After making sure that the shutter is in proper position for making the exposure, the camera can be taken out into daylight and attached to the kite. A fairly stout rubber band looped around the middle of the camera box and around one of the wooden struts of the kite will hold the camera securely in place. The camera should always be fastened to the kite in such a manner that it points almost straight downwards when the kite is in flight; then the pictures give the impression of great height.

The kite used for taking pictures from above should be fairly large and of good construction. The box type of kite is very suitable for the purpose, and many other forms will also prove very satisfactory. Besides the pleasure of making pictures of our familiar surroundings from above, and the great novelty of such pictures, a kite camera can also be used for many practical purposes



Large sheave wheels can be turned out accurately without the use of a lathe if care is taken in adjusting the timbers and handling the gearing

Turning Out Large Sheave Wheels Without a Lathe

IN turning out sheave wheels of large diameter, a lathe is not always available. The work can be accomplished in the following manner:

Place two large timbers over the motor-pit (which should be parallel to the line shaft), and put spreaders between them. Bolt the timbers together and brace them up. The sheave wheel is then swung between them, as shown in the diagram. Remove the hand-chain wheel from a 2-ton chain-block and substitute a 14-inch pulley for it. Take off one of the lift-chain wheels and insert the square end of the lift-chain axle in the square socket previously cut in the end of the sheave wheel. Bolt down the chain-blocks with two U-bolts to a piece 12″ by 12″.

A heavy steel plate is then placed across the timbers in front of the sheave wheel, on which is mounted the extra tool post-head of the lathe. With this arrangement, the speed may be reduced and sufficient power gained for practical work.—H. V. ABELING.

A Two-Jaw Chuck

THOSE who have a wood-turning lathe sometimes find need of a small chuck. The following will be helpful to them:

The frame *A* of the chuck (Fig. 1) may be made from a wagon-tire or other piece of steel ⅛″ thick and 1″ wide and as long as necessary. Bend over about ¾″ at each end, being careful to make the corners square. Drill a small hole in the exact center of the frame for the center *G* of the shaft (Fig. 2).

Fit a round iron ring *B* snugly on the shaft. Fasten this ring on the shaft with a key, set-screw, pin or the like. Secure this ring to the frame with four strong rivets *D*, Fig. 1.

Cut two slots *C* (Fig. 1) in the frame, as shown in the diagram. This is the hardest part of the work. The best way

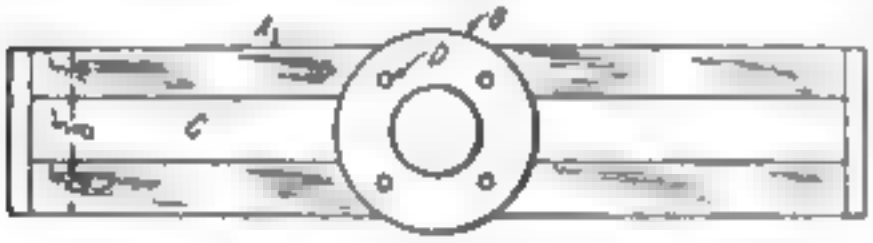


Fig. 1. Top view of the chuck, showing its parts and construction

is to drill holes not quite as wide as the slot, but as long, and file square. This will require patience.

The jaws *E E* (Fig. 2) will require some sawing and filing, but are not as hard to make as the slots. Get two pieces of steel 1″ square and 1½″ long, and file them to the shape and dimensions shown in the drawings, being careful to make the surfaces that slide on the frame fit as snugly as possible.

Thread two ¼″ bolts, *F*, round one end and file two flat places on the other, so they can be turned with a wrench. Drill a seat in the ring *B* for the round end and let the other end project about ¼″ through the holes at *K K* (Fig. 2).

Drill a small hole close up to the end

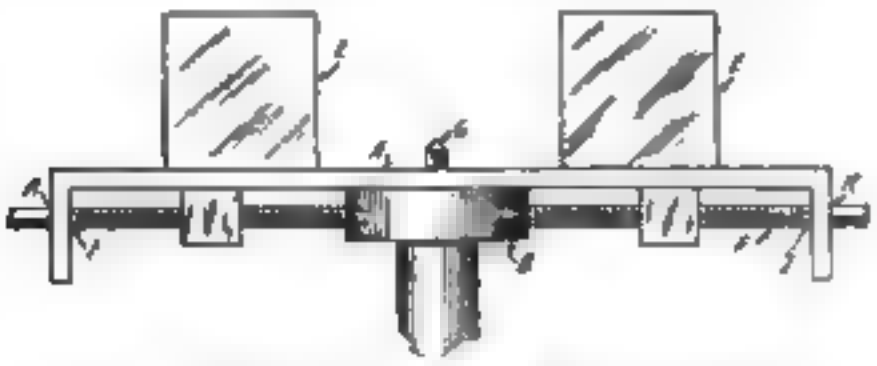
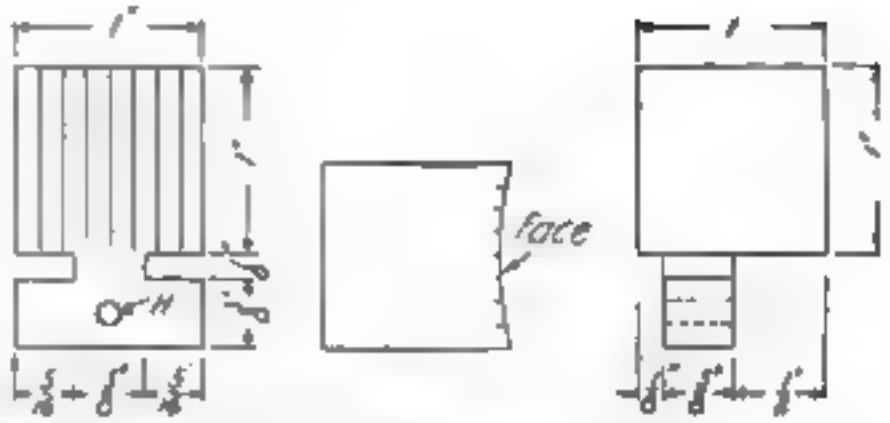


Fig. 2. Side view of the chuck in position on the shaft



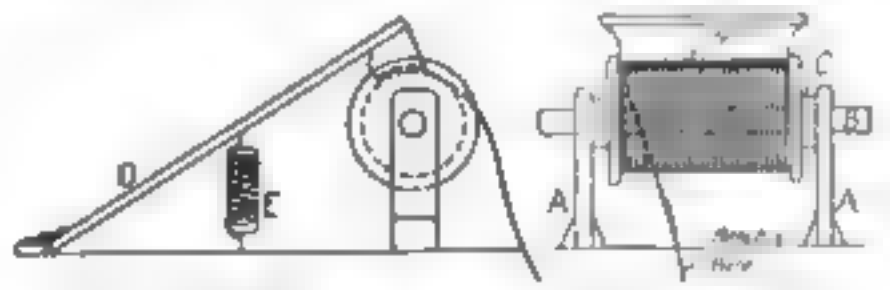
Construction details of jaws of the chuck

of the frame and put a small pin through it to keep the bolt from coming out; or screw a small collar *I I* up as far as it will go and fasten it there (Fig. 2). The bolt goes through the hole *H* in the jaws, which is tapped to fit. By turning the bolt the jaw may be made to slide along in the slot.

To get the jaws in the frame, the upper end of the slot must be widened. Then the jaws may be put in the slot and turned around

How to Wind Springs Easily

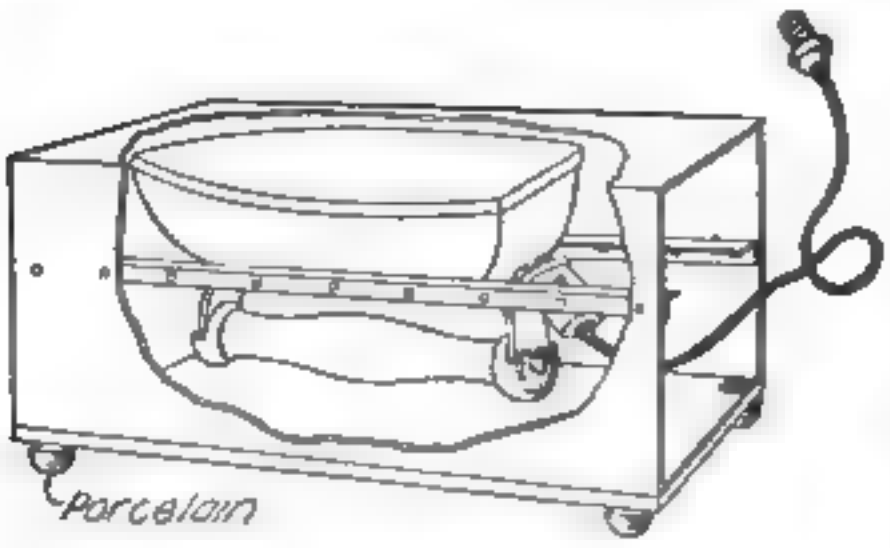
WHEN winding small springs with a lathe, much time is consumed in unraveling the wire from the spool, which is necessary to prevent tangling. The following method is quick and saves the end pieces. The supports, *A*, *A*, shown in the diagram, may be fastened



With this scheme, time and wire are saved in winding small springs on a lathe

directly to the bench, or to a board.

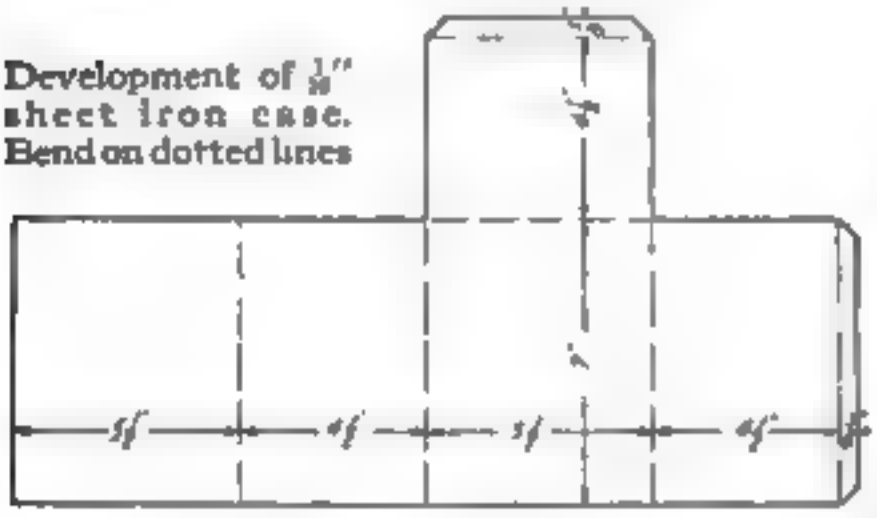
Drill holes in each support to receive the rod holding the spool. A collar *C* for holding the parts together, is fastened to each end of the shaft inside the supports. The board *D* is attached to the bench by a hinge, as in the diagram. On its upper end is a block of wood, which fits over the spool between the flanges. A piece of heavy felt is attached to the under side of the block. This takes up the irregularities, when the layers of wire change. The spring *E* holds the block firmly against the wire. The tension on the spring should not be so great as to cause trouble in pulling the wire from the spool.—C. ANDERSON.



An electric iron, supported bottom side up, makes an excellent electric stove

Using an Electric Iron as a Stove

AN electric iron can be converted into an electric stove with the aid of a case cut from a sheet of stiff iron according to the dimensions given in the accompanying illustration, and bent and riveted as shown. The iron rests on angle irons riveted to the sides of the case. Wires carrying electric current to the heating-coil should enter the case through a porcelain tube in the base.



Development of ¼" sheet iron case. Bend on dotted lines

How to Make a Leveling-Board

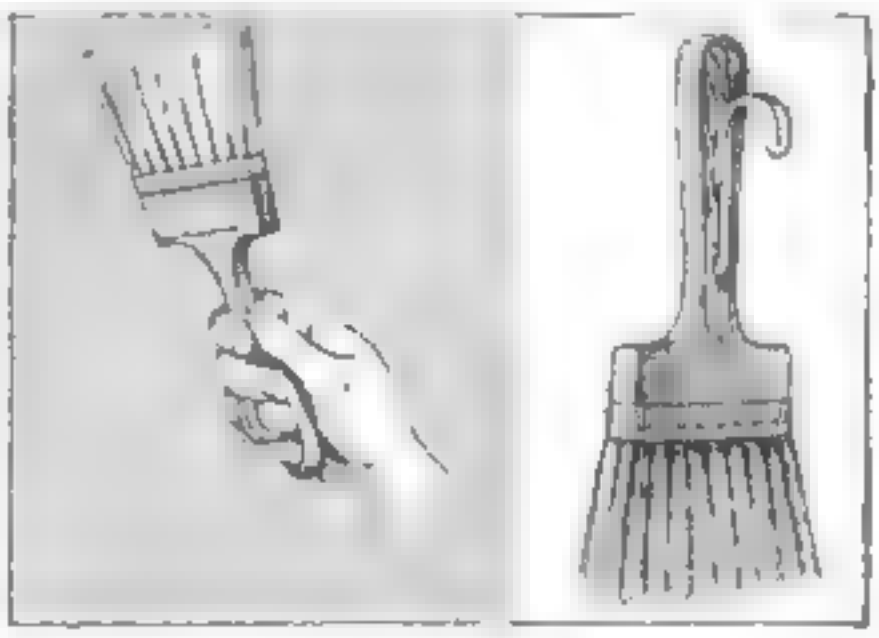
AN excellent leveling-board can be made from a rough board and a few nails. Attach two pieces of wood to the ends of the board, temporarily, allowing them to project slightly beyond the edges. To these pieces fasten a strong thread or cord, drawn as tightly as possible without breaking. Lay the board on its side and, every few inches, drive small nails in the edge of the board, making the head of every nail even with the thread. In the same way, drive a few nails in the opposite edge, near the center of the board, for the level to rest on, taking care that the opposite edges are parallel.—J. L. BAYLEY.

A Handy Drawer-Catch

TO keep the contents of a drawer in the workshop safe without using a lock, so that the drawer cannot be opened by outsiders, drill two holes in the closed drawer, one on each side, through the top of the bench into the strips on which the drawer slides. To lock the drawer all that is necessary is to pass a bolt through each hole. A jig, fixture or a heavy piece of metal is then placed over each bolt so that they will not be detected. The bolts should be a snug fit so as to avoid rattling of the drawer.

A Paint Brush Hook

THE handy man who has had his paint brush fall in the dirt will appreciate this simple and easily-made device which effectually prevents the brush from slipping out of the hand. A small gimlet or a hand drill and a pair of pincers are the only tools necessary. A piece of fairly heavy wire is bent into the shape illustrated, the two projecting ends are inserted into the holes in the handle of the brush and are bent flat on the opposite side. The brush is grasped as usual, the hook coming between the two middle fingers.—F. P. BAEYERTZ.

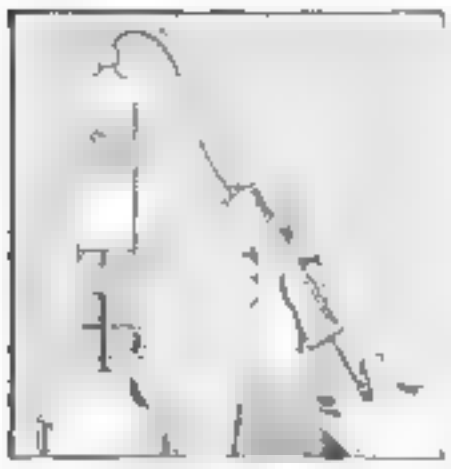


A hook helps to hold the paint brush in the hand and also to hang it on a bucket edge or ladder rung

To Bore Endwise in Wood.

IT is often necessary to bore in the end grain of wood. The ordinary bits, however, catch in the wood and split it. This can be overcome by using bits which have had the lips filed off. This simple expedient will obviate any further trouble.

Filtering Mercury

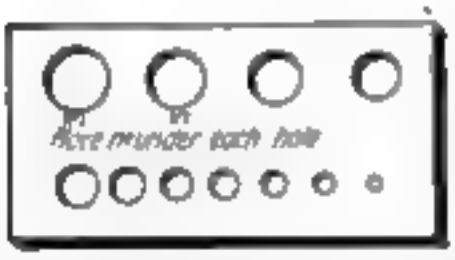


THE mercury used in a laboratory for experimental purposes often picks up particles of grit or metal filings that can be most easily removed by filtering. This should be done under pressure

Put the soiled mercury in a glass syringe tube. Closing the small end with the finger, insert a thin section of perforated cork, then some asbestos wool, and finally a perforated India-rubber cork. The asbestos should be sufficiently tight to prevent the mercury from passing at ordinary pressure. Tie on the cork with twine and invert over a suitable vessel. Then compress the air above the mercury by means of a cycle-pump, using only just enough pressure to drive the metal through the filtering material. It will come out clean and bright, leaving the impurities in the asbestos fibers.

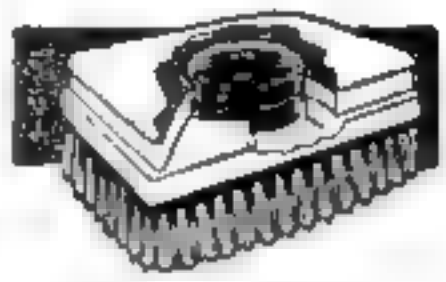
As the wide end of a syringe tube has a distinct rim, there will be no difficulty in wiring the cork in position to avoid the possibility of its being forced out by the compressed air.—H. J. GRAY.

A Simple Bit Gage



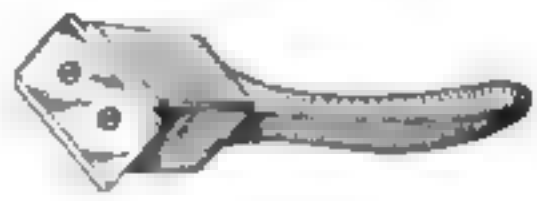
THE amateur mechanic who relies upon his sense of touch or "feel" to select a bit of the proper size, frequently makes the mistake of choosing the wrong size and thus drills a hole which may be too large or too small for his purpose. This source of error may be eliminated if a piece of sheet brass is perforated with a number of holes corresponding in size with the bits in one's outfit. The sizes should be marked in the brass beneath each hole; and when a particular bit is wanted, the desired size can be determined by inserting the bit into its corresponding hole. By this method errors are easily avoided.

Blacking Box Inside Brush



A BLACKING box can be made, which is lodged inside the polishing brush. To this end the large and flat brush has a wood backing which is hollowed out at the middle for fitting in the blacking box. A second wood piece of the same size as the brush backing is applied upon the latter and it is also hollowed in the center, so that the blacking box is contained in the cavity formed between the two wood portions. The top wood piece is held on in any suitable way which will allow it to be readily removed and replaced.

Razor Blade Floor-Scraper



A VERY serviceable floor scraper can be made very quickly from a piece of wood and an old plane iron. The handle should be shaped from hardwood to which the plane iron is fastened as shown. Besides using it on the floor it will be found very handy for scraping off old paint.

A Novel Polishing Pad

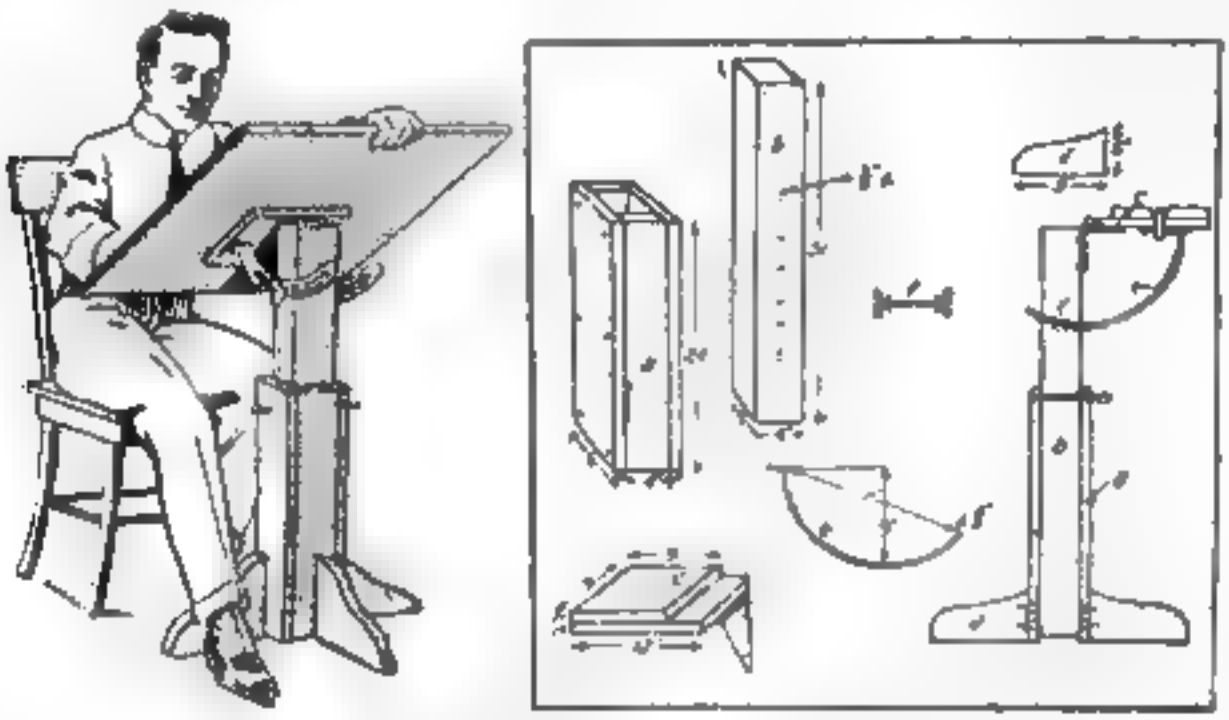
A VERY useful and efficient polishing pad may be easily made with a small empty spool, some cotton-wadding and a piece of flannel. Cut the flannel in a circular form about eight inches in diameter, placing the cotton-wadding in the center, the outer portion of the flannel being drawn in and tied firmly to the center of the spool. When polishing operations are to be commenced, simply pour the polish through the whole in the center of the spool.—GEORGE H. HOLDEN.

A Handy Drawing Table

A DRAWING table, which can be adjusted for height and angle, will amply repay its builder in convenience for the time and pains spent in its construction. The materials are reasonable in cost.

After the stand is constructed, any drawing board may be attached to the upper part, and the screw-heads should be countersunk

A complete list of the materials required is as follows:



A drawing table which can be made by an amateur. The diagrams show the structural details

2	Wood strips	24″	x	6″	x 1″
2	" "	24″	x	4″	x 1″
4	" "	9″	x	6″	x 1″
1	" strip	31″	x	4″	x 1″
1	" "	9″	x	9″	x 1″
1	" "	12″	x	9″	x 1″

2 lengths of iron rod $\frac{3}{8}$″ x 12″

1 heavy barn-door hinge.

1 bolt 2″ x $\frac{3}{8}$″ with a thumbscrew tap.

1 bolt 5″ x $\frac{3}{8}$″ with two 1″ washers and two thumbscrews.

1 pin (a cheap screwdriver with the flat part filed off will do).

Acid Engraving in Steel in Your Own Handwriting

TAKE the tool to be marked, and heat it until it melts wax. Rub and melt wax over the area which is to be etched and harden the wax by cooling. Do not heat the wax and rub on a cold tool, as it hardens too quickly and does not hold, when writing on it. Use a pointed file or scratch-awl to mark or write with. A fine point makes a fine line; a flat point makes a wider line. Write or mark through wax, so that the writing tool touches the steel; blow off crumbs of wax and apply the acid.

Formula—Etching Acid

Muriatic Acid .....1 part
Nitric Acid .....1 part
Water .....1 part

Mix in bottle, using a glass stopper as other corks do not last.

Apply acid with a fountain pen filler very slowly. Etching should continue until the acid turns a rusty color. Then wash off the tool in water, heat it and wipe off the melted wax with a cloth. Polish the tool. Oil it to prevent reaction of water to rust. Do not put the used acid back in the bottle, or allow the smallest drop of acid to touch any uncovered part of the tool, as it will eat a hole in it

All this takes about five minutes. To retard the action of the acid in etching, add another part of water. This is only done when a number of tools are to be etched.

It is best to wax all at one time, writing on all, and leaving the etching as a last operation. Do not leave the bottle containing the acid near any tools. The fumes will rust them.

Lighting a pipe in the wind is difficult because it is hard to keep the match burning until it reaches the pipe. Scratch the match on the pipe, and all such troubles will be avoided

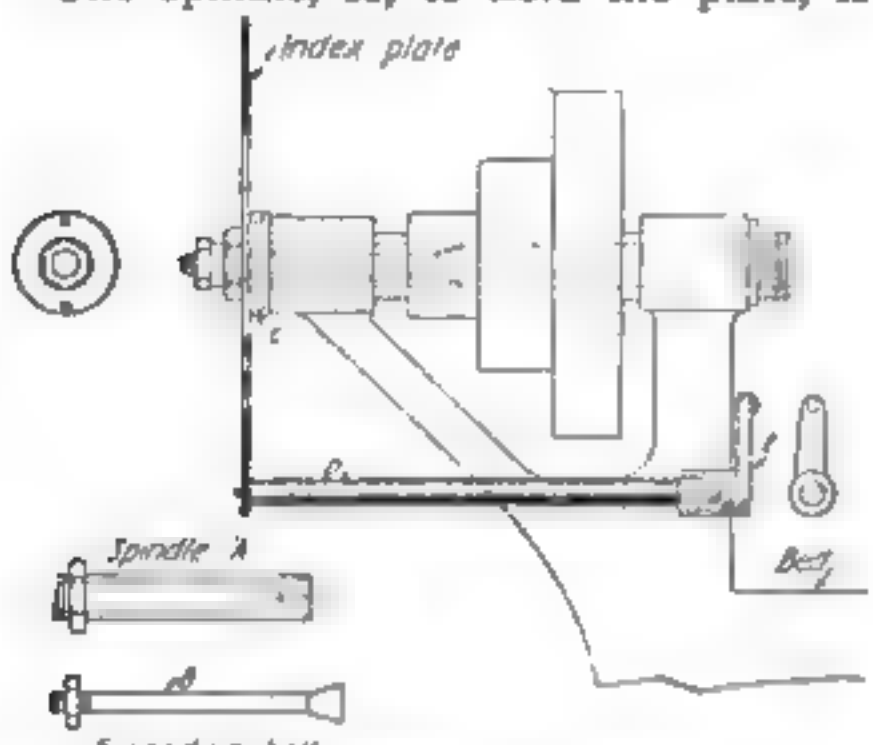
Lighting Your Pipe in the Wind

A MATCH - SCRATCHER, easily shielded from the wind by the hand, is formed by making grooves on the side of one's pipe with a three-cornered file as shown in the illustration.—THOMAS SHEEHAN.

Attaching an Index Plate

BY the following plan, an index plate can be attached to a hollow spindle lathe which has no convenient place for attachment.

The spindle, *A*, to hold the plate, is

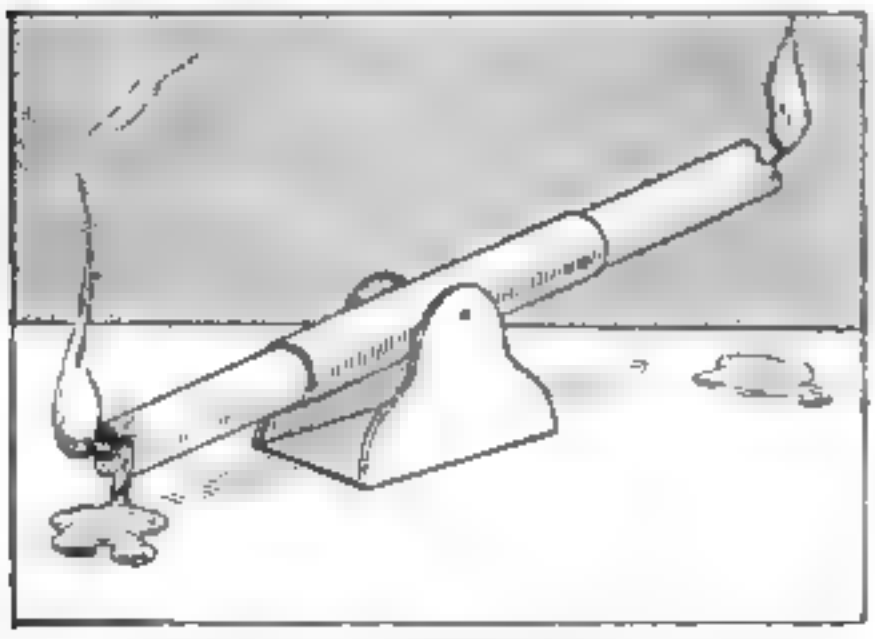


A convenient method of attaching an index plate to a hollow spindle lathe

turned to fit the bone of the lathe spindle and has a ¼″ hole drilled through the center. One end is tapered and split to receive the tapered bolt *B*. The plate should have two pins riveted to it to fit the holes in the spindle end. The bar *D* and the arm *E* are made according to the design of the lathe.—A. H. JOHNSON.

A Candle Motor

AN interesting and novel form of motor can be made from two ordinary tallow candles. When properly made, the motor will have a rocking or seesaw motion due entirely to the melting of the burning candles.



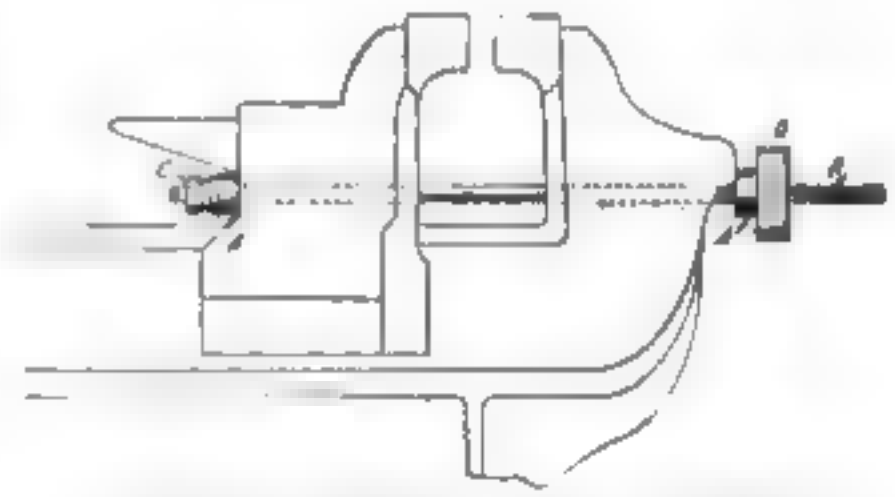
The lower candle burns faster than the upper, and, becoming lighter, is raised. The seesaw motion continues, therefore, as long as the candles last

As the illustration shows, the device consists of a cardboard tube having an inside diameter to receive the candles snugly. The tube is hung on an axle in the center of a wooden stand or bearing made of three simple pieces of wood, as shown. The tube should be fairly well balanced. Candles are then inserted in the ends, also well balanced. If one end proves heavier than the other, light the candle at the heavy end, and allow the tallow to melt until that end rises; then light the other candle. The alternate dripping from the two candles will cause the tube to rock back and forth like a walking-beam. It will keep going until the candles are entirely consumed.—CHARLES I. REID.

An Emergency Vise Repair

HAVING broken the threaded shaft of a 3″ vsei it cao be repaired as follows:

Take two pieces of brass 2″ by ⅜″ by ¼″ and in the center of each piece bore and tap a hole to admit an 8-32 thread.



A vise repair which can be made quickly in case of an emergency

A threaded brass rod 6″ long, two knurled nuts and a knurled 8-32 nut about ¾″ in diameter are the other materials needed.

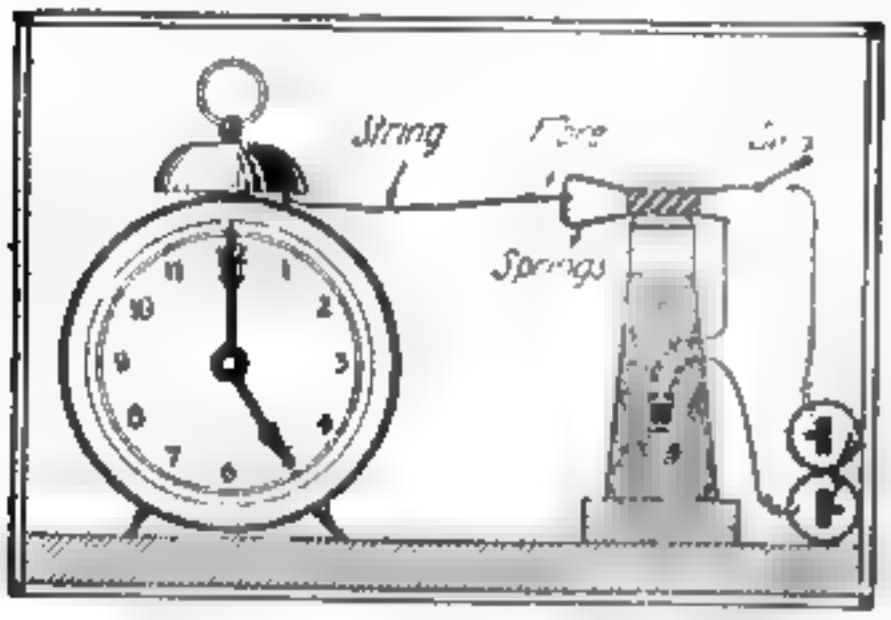
The various parts are assembled as shown in the diagram. The brass bars are marked *A*, the threaded rod, *B*, the small knurled nuts, *C*, and the large nut, *D*.—T. W. B. BEST.

A Trick in Sawing

AMATEUR carpenters often have difficulty in sawing a square cut. If when starting to saw they will hold the saw so that the reflection of the work extends in a straight line, there will be no difficulty in sawing the wood at right angles with the edge.

An Electric Alarm Operated by a Clock

A GOOD electric alarm-clock is suggested in the accompanying illustration. A small fibre pin is inserted between two bent springs and attached by a cord to the hammer of an alarm-clock.



When the alarm goes off the fibre pin is pulled out, the wires make a circuit, and the electric bell starts

When the alarm goes off, the fibre pin is jerked out from between the springs. They close like teeth and complete an electric circuit which consists of dry batteries and a door bell. A switch, *SW*, opens the circuit.—J. W. KLAUS.

Protecting Labels on Bottles

INSTEAD of coating the labels of chemical bottles with paraffin, the usual rule, a better plan is to coat them with a mixture of candle wax and petrol. After this is applied, a high luster can be obtained by painting the surface with a solution of "white lac" in methylated spirits. The result is a brightly varnished label which is impervious to most chemicals.—G. E. WELCH.

Workbench Made From Old Piano

OLD square pianos that have outlived their musical usefulness can be bought very cheaply, and the solidness with which they are constructed fits them admirably—after a few important alterations have been made—for workbenches. All of the mechanism should be removed, including the keyboard, and the piano body sawed to the desired height. The top may be replaced when the height has been shortened, and it makes a substantial table. The exact type of the piano and the tools which are available to the workman will decide the details of the reconstruction

The piano from which the writer constructed a workbench has proved a source of other value. About fifty feet of well seasoned lumber were secured, several gross of screws from the action, several pounds of lead and a basketful of good ivory. The strings and felt will also find future use.—T. E. WHITE.

A Library Paste Which Does Not Dry

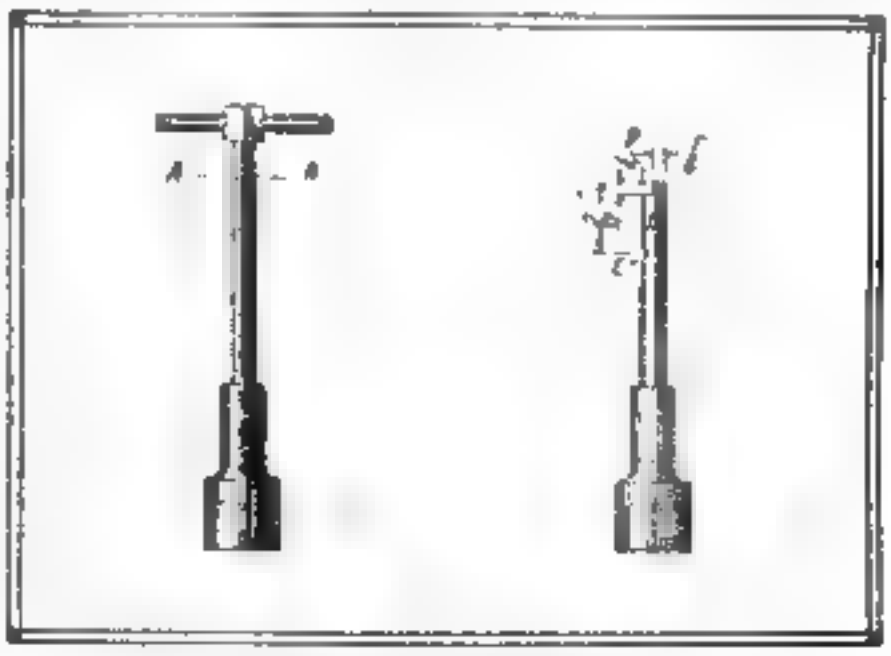
A JAR of library paste can be prevented from drying out by the following procedure:

Break off a piece of glass tubing just long enough to reach to the bottom of the jar. In one end of this tubing place a wad of cotton and push the end containing the cotton down through the paste. In the open end pour a little water which will gradually seep through, moistening the paste. The paste will be moist but not watery.

—LOREN THOREAU WARD.

Handling Small Bolts Easily

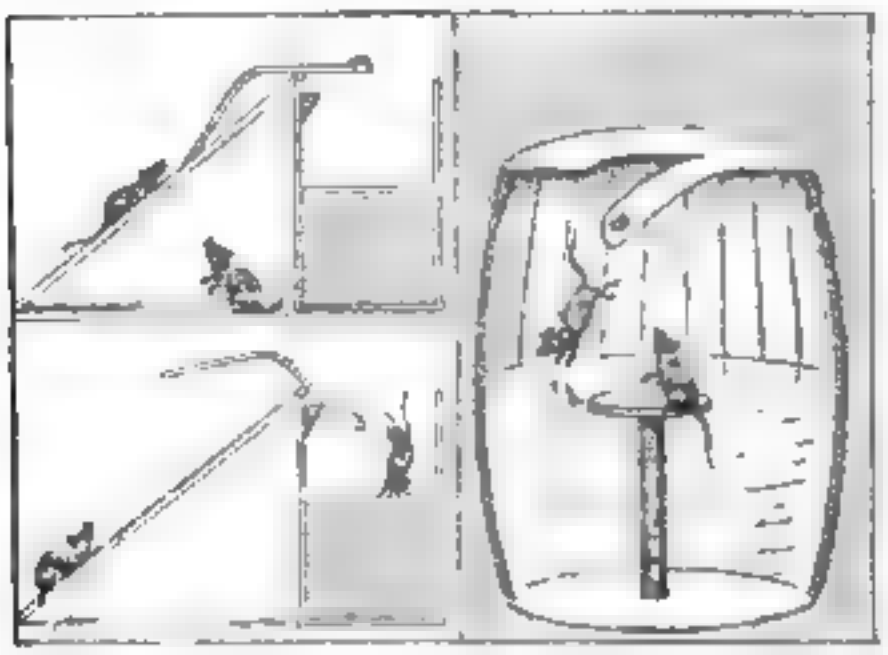
A TOOL for turning small bolts can be made from a discarded socket wrench. The handle of the wrench should be cut off, and the protruding spindle machined, as shown in the accompanying illustration. The finished spindle will readily fit an ordinary "Yankee" screwdriver.—B. G. MCINTYRE.



Small bolts are easily handled with this rebuilt socket wrench

Catching Rats Wholesale

WHERE there are many rats, a trap which will catch a large number, without being reset, is a great advantage. An excellent device may be made from a large bucket, half-filled with water.



Many original rat-traps have been devised by the soldiers in the trenches, where the vermin flock in droves. Here are two of the traps, now in use

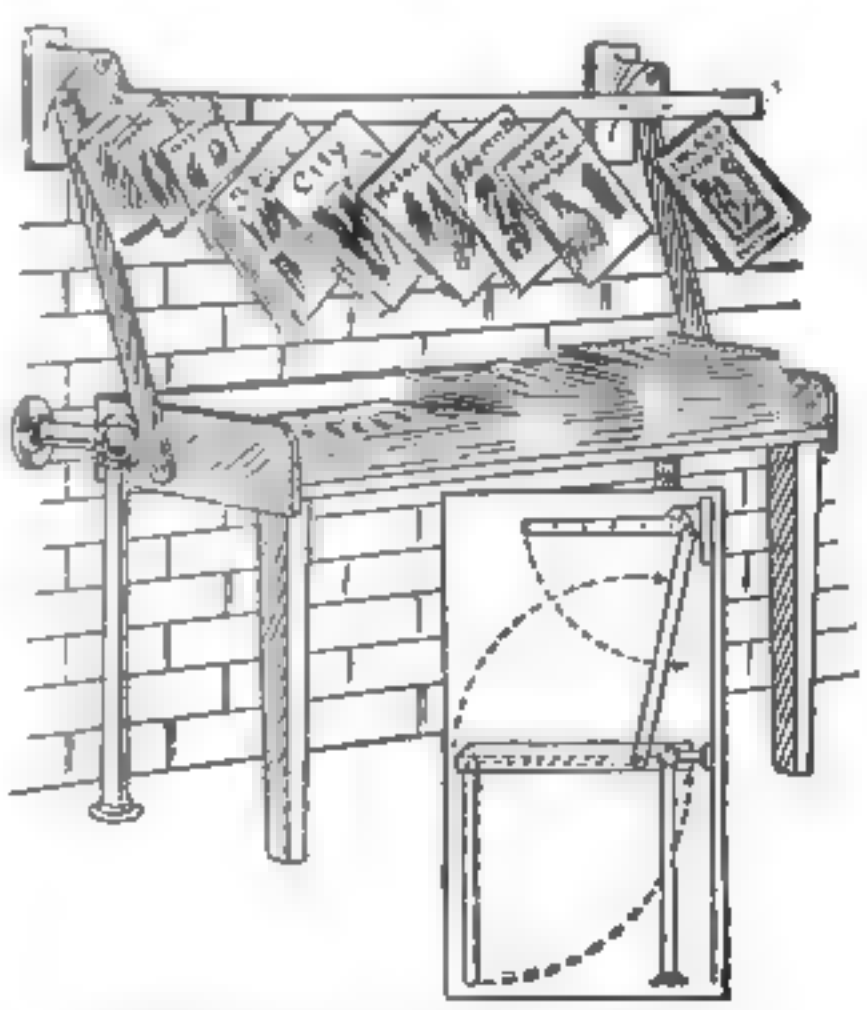
Place a board against the edge of the bucket for the rats to ascend. Provide a metal piece, which can be pivoted at the upper end of the board and bent into the shape shown in the diagram. The pivoting may be easily effected by simply stretching a wire over the flap and fastening it to screw-eyes in the end of the inclined board. Place lard or bacon at the overhanging end of the metal piece for bait. The rats ascend the inclined board; when the bait is reached, their weight overbalances the upper flap, and they plunge into the water, the flap resuming its original position.

Another good method requires a barrel of water. Attach a small board to the end of a stick and place this in the barrel vertically, so that the board forms a small platform, which should be submerged slightly in the water. Cover the top of the barrel with parchment or even strong paper or cardboard. Make a U-shaped cut in this covering to form a tongue for holding the bait. A rat approaching the bait is precipitated into the water. He soon reaches the platform and cries out in distress; other rats come and they also fall into the water. A fight for the board ensues and the would be rescuers are slaughtered together with the original victim.—F. P. MANN.

A News Stand and Blueprint Washer Combined

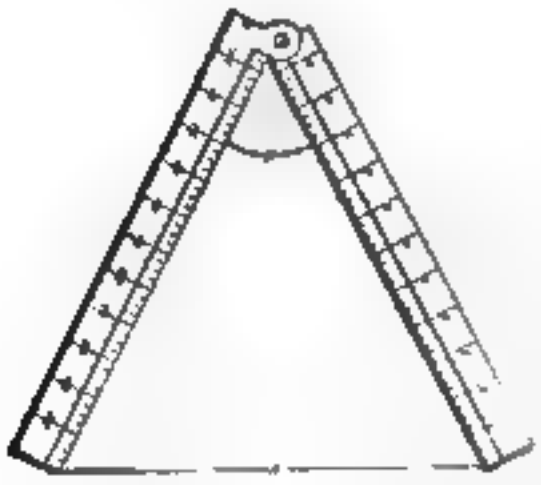
A COLLAPSIBLE news stand which can be turned to the desirable, if not closely related use of blueprint washer can be made effectively from ordinary ⅞″ lumber and 1″ piping. The piping adds much to the rigidity of the news stand and offers the opportunity for the extra use of blueprint washer with the simple assistance of a garden hose. The magazine rack makes an excellent drying place for the blueprints.

As constructed, the stand will fold close to the wall and can be hooked or locked in position. The main support of the stand is made of 1″ piping, fastened to wall and sidewalk. The shelf turns on the elbow fitting which is also the outlet for the blueprint washing system. The front legs are hinged and shut back on the shelf when it is closed. The rack is set out from the wall by a bracket built so that when the shelf is closed up against the wall, the guards push the back of the rack pinions up and drop the rack down inside the shelf. This closes the entire apparatus inside the shelf with the exception of the front legs, which can be locked down.



The magazine rack can be turned into a blueprint washer. An inventive boy designed and built this

Laying Out Angles with a Two-Foot Rule



The two-foot rule can lay out angles

THE average carpenter who has any occasion to lay out an angle which does not require absolute accuracy, such as can be obtained with a protractor, can secure fairly accurate results with the use of the accompanying table. A standard two-foot rule is required. By opening the rule to different angles we secure corresponding varying openings measured in inches between the edges of the rule, as designated by the letter *A*. Suppose we wish to measure an angle of 20°. By consulting the table for 20°, we find the distance *A* to be 4 5/32″. Using a pair of dividers or an additional rule, spread the two-foot rule apart until the distance *A* measures 4 5/32″ in length. Then the angle *B* will measure 20°. The table has been computed within 1/32″, that being sufficient for all practical purposes.—S. H. SAMUELES.

TABLE FOR LAYOUT OF ANGLES BY TWO-FOOT RULE

B DEG	A INCH	B DEG	A INCH	B DEG	A INCH	B DEG	A INCH	B DEG	A INCH	B DEG	A INCH
1	1/32	16	1 15/32	31	6 1/32	46	9 1/32	61	12 5/32	76	14 31/32
2	1/16	17	3 1/32	32	6 1/8	47	9 5/32	62	12 1/8	77	14 27/32
3	1/8	18	3 1/8	33	6 11/32	48	9 1/8	63	12 7/32	78	15 1/8
4	5/32	19	3 15/32	34	7 1/32	49	9 3/16	64	12 15/32	79	15 1/8
5	1/16	20	4 1/32	35	7 3/16	50	10 1/32	65	12 31/32	80	15 5/16
6	1/8	21	4 1/8	36	7 1/4	51	10 1/16	66	13 1/32	81	15 13/32
7	1 5/32	22	4 5/32	37	7 3/8	52	10 1/8	67	13 1/8	82	15 1/2
8	1 1/4	23	4 15/32	38	7 1/2	53	10 3/16	68	13 5/16	83	15 29/32
9	1 3/8	24	5	39	8 1/32	54	10 15/32	69	13 15/32	84	16 1/16
10	1 1/2	25	5 1/8	40	8 1/16	55	11 1/16	70	13 3/4	85	16 1/16
11	1 5/8	26	5 1/32	41	8 1/8	56	11 1/8	71	13 27/32	86	16 1/8
12	1 3/4	27	5 3/8	42	8 7/32	57	11 9/32	72	14 1/8	87	16 13/32
13	1 13/16	28	5 1/2	43	8 5/16	58	11 3/8	73	14 5/32	88	16 1/2
14	1 15/16	29	5	44	9	59	11 15/16	74	14 1/16	89	16 15/32
15	2 1/32	30	6 1/32	45	9 1/8	60	12	75	14 1/8	90	17

By following this table, an angle of any degree, from the smallest to the full right angle, can be laid out with an ordinary carpenter's two-foot folding rule

A Simple Way of Making Facsimile Rubber Stamps

LAY a piece of carbon copying paper face up upon a smooth table. Over this, place a sheet of paper and with a lead pencil write the name. The name will be reproduced on the back of the paper. Lay the carbon paper face down upon a piece of very smooth zinc, and upon this, place the paper on which the name has been written, this also face down. Then with a pencil go over the lines, which now read backwards, thereby tracing the lines upon the zinc.

Next, prepare an acid proof ink by mixing equal parts of pyrogallic acid and sulphate of iron. Go over the lines on the zinc with a pen dipped in this ink. When dry, apply hydrochloric acid to the face of the zinc. After it has eaten deeply enough, wash off the acid in running water.

A plaster cast is then taken and a reproduction made with rubber in the manner described in the March, 1915, number of MODERN MECHANICS AND THE WORLD'S ADVANCE. The zinc can also be mounted type-high on a wooden block and used in a printing press

For those who are not experienced in vulcanizing rubber or who do not care to go to the trouble, the following is recommended: India rubber, cut up into small pieces, is dissolved in highly rectified spirits of turpentine until semi-fluid. This is then poured into the plaster cast, which has been previously dusted with powdered graphite.

Experimental Electricity

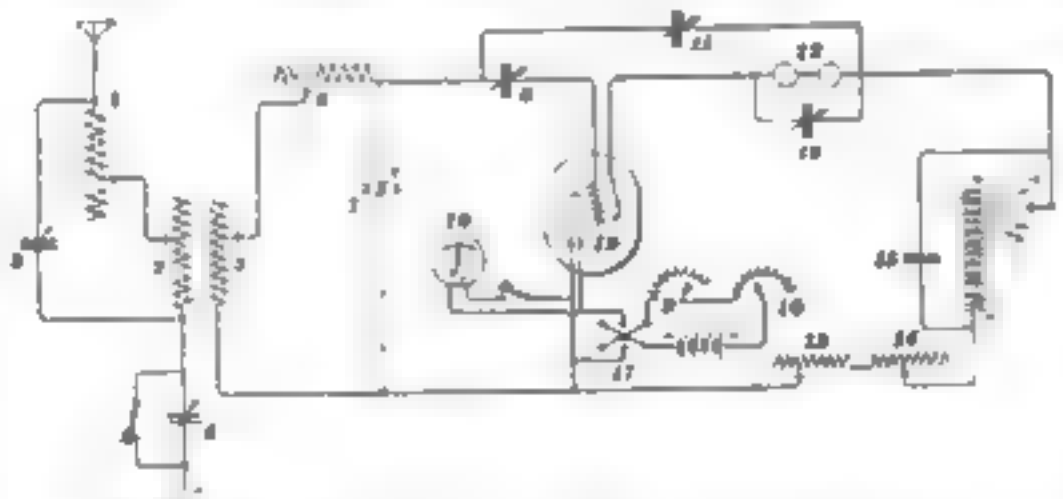
Practical Hints for the Amateur

Wireless Communication

An Undamped Wave Receiver

By W. Ross McKnight

YOU are missing much enjoyment, if your wireless set is not equipped to receive signals from stations employing undamped ("continuous") waves. Arlington transacts considerable business with a Poulsen arc transmitter. Tuckerton and Sayville, working with Germany, use undamped waves, as well as a new government station, NAJ, on the great lakes. A number of other stations which use arc sets are located on the Pacific Coast and in the Southwest. Notable among them is the new Navy station at Darien, Panama Canal Zone with call letters UBA. It is expected that others will be established from time to time. Again, it is not impossible for the advanced experimenter to "get" the Nauen and Eilvese stations in Germany, if he be in position to erect an aerial some six hundred or more feet long.



Wiring diagram of the undamped wave receiver

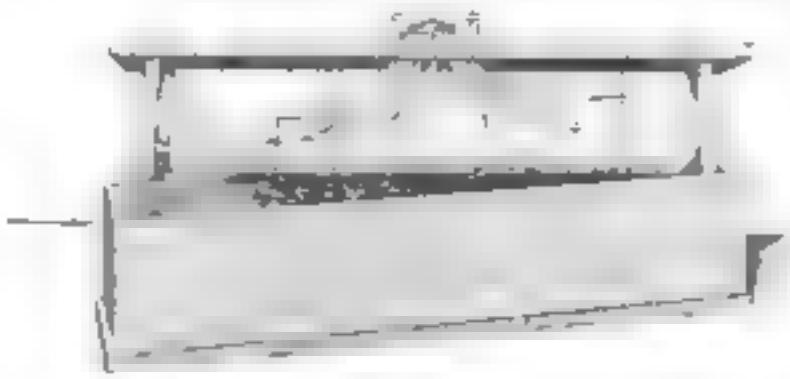
Persons who have experimented with the audion detector have found that it may be rendered extremely sensitive to some spark signals by certain critical adjustments of the lighting and high voltage batteries. When in this state, the audion is a perfect generator of high-frequency oscillations. Not every bulb, however, can be made to "oscillate" merely by adjusting either or both of the battery systems. Also, this condition, when obtained by these means, is not stable and reliable, nor is it flexible enough to accommodate itself to tuning to various wavelengths and to various spark-frequencies, both of which are important considerations.

Consequently, instruments and manipulations are wanted that will enable one to turn his audion into a high-frequency generator with the certainty and reliability that water may be turned from a faucet.

The following information will enable any amateur having an audion, to receive signals from undamped wave stations located within, say, 1000 to 1500 miles, and, under favorable conditions of

location and skill, from the Navy station at Darien, which is about 1800 miles from Washington. He may also receive signals from spark stations many hundreds of miles farther away than before, and "bring in" the stations which he has been hearing from two to ten times as loudly as before.

The accompanying illustrations portray an arrangement of three tuned circuits, the open (antenna) circuit, the secondary circuit, and the audion wing (high potential) circuit. The various condensers and inductances shown are the usual tuning devices.



How the inductance coils are made

The antenna in use with the set here described consists of two stranded copper wires 250′ long, spread 4′ apart on bamboo spreaders, raised 30′ above level ground, located up in the mountains of northeastern Pennsylvania. The antenna, with the aerial tuning inductance, primary of inductively-coupled tuner and the condenser shunted around the aerial tuning inductance and the primary winding, permits of tuning to resonance with from 1000 to 8000 meters wavelength. Tuning to shorter wavelengths may be done by cutting in the condenser shown in the ground wire. With this set it has been easily possible to read signals from the Navy station at Darien, Panama, day or night, ever since the station was opened.

The constants of the aerial, inductances and condensers may be varied, of course, and those in use or on hand in most advanced amateur stations may, perhaps, serve the purpose; but in the aggregate a fine degree of resonance must be procured. All inductances (save those of the tuner) are in oak boxes; the tubes are fastened to the lids by brackets, with the switches on top of the lids. This arrangement permits the entire unit to be lifted out of its box without disturbing connections, if desired. Tap leads inside are covered with soft rubber tubing. Coil boxes may be placed on end to save space.

The tuner is of the familiar inductively-coupled navy type; the inductances in both tuner circuits are variable by switches only, 16 ten-turn and 18 one-turn in the primary, and 12, equally spaced, in the secondary. Inductance 1 is made of a paper mailing tube, 3″ outside diameter, 18″ long, and wound closely over 16″ of its length with No. 25 DCC wire. Including the ends of the winding, ten taps, equally spaced, are led to a ten-point switch. Inductance 6, in the secondary circuit, is made of a paper mailing tube, 3″ by 18″, wound closely for 16″ with No. 36 DCC wire; and 10 equally spaced taps are led to a ten-point switch. Inductance 13 is identical with inductance 6. Inductance 14 is of the same dimensions but it is wound with No. 25 wire for use when tuning to shorter wavelengths, and to permit fine variations in conjunction with inductance 13 when tuning to long waves. All condensers (except that around the high-potential battery) are of the familiar segmental variable type, with range of capacity from 0.0008 to 0.001 mfd. Condenser 3 is filled with castor oil, giving it a maximum capacity of approximately 0.004 mfd. It is used to boost the wavelength of the antenna circuit.

Rheostats 9 and 10 are employed to regulate the filament voltage. One is the ordinary rheostat that is a part of every audion detector. It has a total resistance of about 10 ohms. The other has a total resistance of only 1½ ohms in 10″ of length. This second rheostat is not absolutely essential, and may be omitted, but it has been found to be very convenient to have such a rheostat for closely regulating the lighting voltage, whether storage or dry cells are used. The condenser 15 shunted across the high potential battery is of the ordinary telephone type, of from 1 to 2 mfds. capacity. Condenser 18 may be either a true variable, or a variable-fixed condenser susceptible of several changes of capacity. The function of these condensers is to provide paths of low impedance, for the high-frequency currents, around the high-potential battery and the telephones. It is considered good practice to have a

condenser across the telephone terminals with an audion detector, however used.

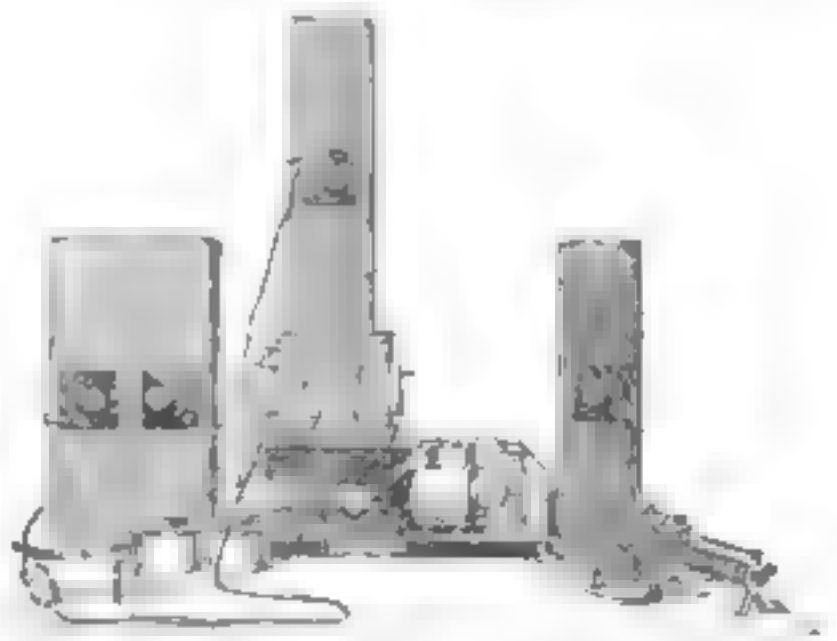
The leads to condenser 15 must be amply protected against any possibility of shortcircuiting the high-potential battery. If a telephone-type condenser is used, after the leads are soldered to the lugs (which are close together) it is a good plan thoroughly to cover the lugs, the solder, and the wires which are exposed, with sealing wax or paraffin. Condenser 11 must be one that does not "contact" inside, for a shortcircuit of the high-potential battery is possible when all inductances are tuned out. It is a good idea to insert a ½ ampere fuse in the high-potential battery circuit.

Condenser 11 is the one most handled in tuning. It is used in conjunction with inductances 13 and 14 to bring the wing circuit into resonance with the secondary circuit, and cause the bulb to oscillate. In the wiring diagram, 16 shows a voltmeter across the filament terminals; though not positively necessary, it is useful. If one gets accustomed to regulating the lighting voltage with a voltmeter, the likelihood of "crowding" the filament is almost eliminated, and hence, a longer life of the bulb may be expected. The bulb may be shaded to prevent strain on the eyes. In the diagram, 17 is a pole-changing switch provided to reverse the lighting battery; it is a very desirable adjunct. Any d.p.d.t. battery switch will do.

Condenser 7, usually used to tune the secondary, is not necessary with this set. Tight coupling is employed with long waves. Any necessary variation of capacity for short waves may be effected by slightly changing the coupling. The fixed condenser usually found within each audion detector, in series with the grid, should be removed or bridged over; the variable condenser 8 takes its place in this set.

Assume, now, that we have assembled these component parts and wish to "pick up" Tuckerton, Arlington, or Sayville—stations working with long wavelengths of from 6000 to 8000 meters:

Couple the tuner closely; throw in all of the aerial tuning inductance and those of both primary and secondary of the tuner; throw in all of the secondary loading inductance; set condenser 8 at about half capacity (according to the scale); set condenser 11 at zero; throw in all of inductance 13 and about half of 14, adjust the lighting and high-potential



Arrangement of complete receiver

batteries as usual, then slowly turn up condenser 11.

The lamp should begin to oscillate, and this will make itself manifest by a peculiar muffled "boiling" sound and a change in the sound of static. A loud or troublesome hissing sound indicates too much high-potential or lighting voltage, or both, and should be avoided; the bulb is not in its most responsive condition when this is present. A very slight blue glow is usually observable in the bulb, back of the wing, when it is doing its best. If immediate results and signals are not secured, raise and lower the high-potential and lighting voltages in various combinations and manipulate condenser 11 until the bulb oscillates. Swinging condenser 8 through its arc, and changing the polarity of the lighting current may have important effects—it depends upon the bulb.

Not all audions oscillate with equal facility, but I have never handled one that would not oscillate with a little patient persuasion. Holding a lighted match to the bulb until the glass is very warm tends to break down its unwillingness to oscillate. The sensitiveness of a given bulb while oscillating seems to be directly comparable to its sensitiveness in ordinary use. Since not all audions, nor even both filaments in any one audion, are equally sensitive, this should be kept in mind so that one will not expect an insensitive bulb to give the finest results, under any conditions.

Experience and observation have shown that the "X" grade Hudson filament bulbs are the most satisfactory and economical.

Once the proper adjustments are discovered, the setting will be practically a constant for a stated wavelength, and it will likely be found that all the undamped wave stations mentioned may be tuned to maximum strength of signals by slight changes in the capacity of condenser 11, perhaps tuning up condenser 3 for Sayville.

The continuous-wave stations are heard in clear, flute-like tones, the pitch of which may be varied in a wonderful and amusing manner by slight change of condenser 8 or 11, or both, or the primary of the tuner, or inductances 13 and 14, or simply touching a metal part of the secondary circuit.

Particularly close tuning with arc stations is necessary, since usually two waves of practically equal energy but of slightly different length are emitted. One of them (the main wave) represents the dots and dashes and the other (the compensation wave) represents the breaks. Some difficulty may be experienced in entirely suppressing the compensation wave, but the difference between the two may always be made sufficient for clear reading.

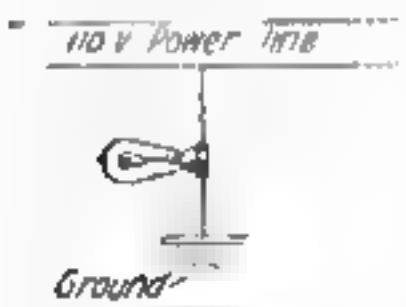
With this set the phenomenon of "stepped-up" voltage of the high-potential battery may be taken advantage of to procure a further increase in volume of signals of spark stations. Arlington's spark signals may be brought in to a degree of loudness painful to the eardrums by throwing in all of the tuner inductances, all of the secondary loading inductance and all of inductance 14, condenser 11 remaining at zero. South Wellfleet (WCC) can be made to "come in" like a grandfather bullfrog by similar manipulation, making due allowance for the shorter wavelength. The same is true, generally, of spark stations anywhere within reach, that work on 1000 meters wavelength or over. A far distant and relatively weak spark station may come in, not with the true note, but with a "whisper" effect. It is usually not practical to obtain perfect oscillation of the audion, resonance with and amplification of signals from stations using wavelengths of 600 meters and under, because of the circuit difficulties involved.

The experimenter who sets out to rig up a receiving set of this character is urged to avoid loose connections, imperfect contact at switches, bunched and parallel connecting wires as much as possible, and sloppy work generally, and to employ persevering patience in tuning the set to various stations until adeptness is acquired. All switch handles should be of good insulating material, and no part of the operator's body should be allowed to come into contact with binding posts, switch levers or bare wires; the capacity of the body will prevent delicate adjustment. The inductances and condensers of the three circuits should be kept separate, each circuit a reasonable distance from the other, say a foot. Proper allowance must be made for the fact that signals that may be coming in ever so clearly may sometimes be almost or entirely suppressed by placing the hand or arm close to certain of the coils or condensers, or even close to the connecting wires. This is particularly true of undamped signals being received on a lower harmonic of the true wave.

Just a few words about winding the coils with the finer wire: Use a lathe, if available, or improvise one with a tool grinder, replacing the grinding wheel with a circular block that will just fit inside the tube; one tack will hold the tube to the block. A similar block, supported and free to turn on a stud, will hold the other end of the tube. By locating the spool of wire on a rod about 25 to 50 ft. away and starting the winding carefully, the whole tube may be wound in a few minutes at high speed; the wire will "feed" itself, barring accident. The taps may then be brought out by lifting the proper turns with the point of a knife blade, cutting the wire, unwinding a turn of each end, twisting them together and soldering the bare ends. The tubes may be wound with the coarser wire by hand and taps brought out as they are reached in winding. Any experimenter whose wireless is equipped to receive undamped waves, should be able to obtain very interesting and valuable results.

Arc Light Interference

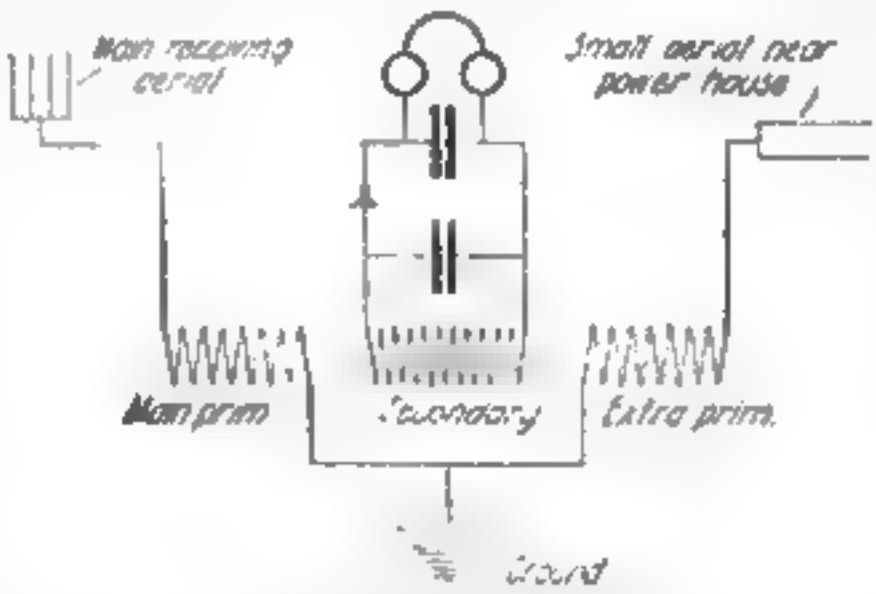
IN the November and December issues of POPULAR SCIENCE MONTHLY there were published several queries and answers on the matter of arc light interference with received signals. Our readers were asked to contribute suggestions which they found helpful in overcoming or reducing this sort of disturbance. A large number of replies have been received, and the proposed methods are here described. It appears that at least two kinds of inductive disturbances are encountered. The first of these is the ordinary "induction hum," heard in nearly all wireless stations that have alternating current power lines running into or very near them. The second type is that which is caused by the flickering and fluttering of carbon arc lights in operation, and which is usually transferred to the receiving wireless aerial by induction from adjacent power lines.



Grounding line through the lamp

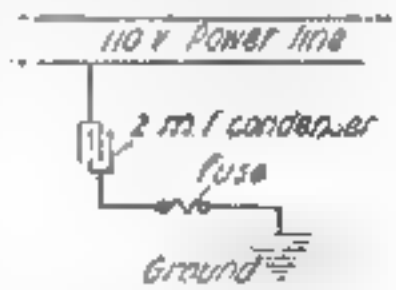
The induction hum is the most common and the easiest to eliminate. It is troublesome when direct-coupled receiving tuners are used, but may often be cut out by changing over to an inductively-coupled receiver. One experimenter states that by running his aerial lead through a fixed condenser before connecting to his tuning coil, he reduced the interference greatly. Another writes that he secured good results by placing a 7-volt tungsten lamp in series with the antenna lead, keeping the lamp lighted to a certain brilliance (determined by experiment) by means of a battery and rheostat. The real reason for any improvement gained from either of these last two methods is not apparent; the use of inductively-coupled apparatus, however, has not only been found effective by practical test, but also is theoretically correct.

Another way of cutting out the hum is effected by merely opening the main switch which brings power into the house containing the receiving instruments. This method prevents internal induction from the leads, but, of course, cannot be used when it is desired to utilize the electric power for transmitting signals or for lights. In some stations the trouble has been stopped by connecting one side of the incoming 110-volt line to ground, through a fuse which will blow on 2 amperes or so, or by grounding through a condenser or small 110-volt lamp. Which of the two power wires is to be grounded through the lamp, condenser or fuse in this way must be determined by trial. In grounding through a condenser the fuse should also be used, for protection in case the condenser punctures.



Balanced primary method of reducing arc light interference

Some of the above methods are effective not only for the alternating current induction, but also for the ragged, harsh noises from arc lights. Especially helpful is the plan of grounding the power lines, for in many cases the arc induction is picked-up by the regular lighting lines and brought to the wireless station over them. Both kinds of disturbance have also been reduced in wireless stations by connecting the diaphragms of the receiving telephones to ground, either directly or through a condenser. Often it helps merely to touch the aerial or ground lead with the finger, or to rest the hand upon a metal plate connected to the blocking condens-



Grounding line through the condenser and the fuse

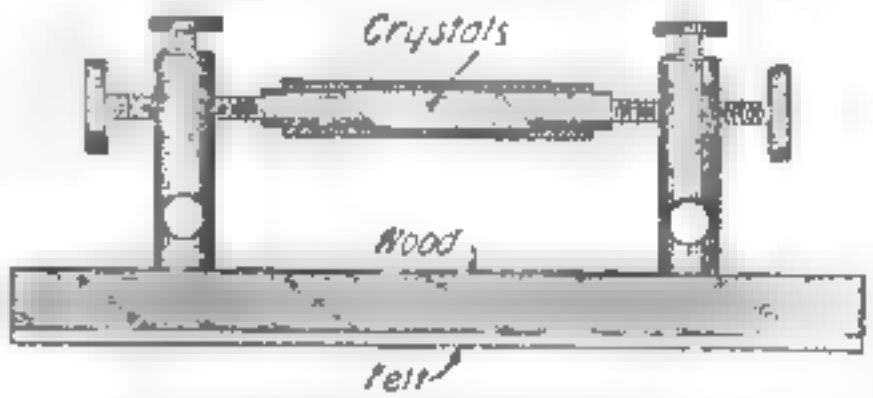
er or one of the telephone leads. Some correspondents have suggested permanently connecting one of the telephone tips to the telephone diaphragm by use of a small metal strip, saying that by trying the several possible combinations, they were successful in finding an arrangement which actually reduced the interference without weakening the signals. A variation of this method is to use the metal-capped telephones and to ground the cases, either directly or through a condenser. Sometimes it is sufficient to connect the case or one of the telephone terminals to the operator's body by bending a piece of tinfoil over the ear-cap and connecting it to the case or cord tip. It has also been found useful to connect together the metal cases and headband, as well as to connect together a certain one of the four tips and the metal case. Which cord-tip to connect in this way must be ascertained by trial.

It has been learned that at a number of stations both the induction and the arc noises can be reduced if the antenna is changed so as to point directly away from the power lines. When the aerial and the 110-volt wires are parallel there is, of course, the greatest inductive effect between them, and when they are about perpendicular the induction is least. Sometimes a position not exactly perpendicular gives the smallest interference, because of an irregularity in the magnetic field around the power wires.

Taken as a whole, the elimination of arc noises remains a big problem at some stations. In many cases the remedies suggested above will reduce the disturbances so much that they will cause no trouble, but it is likely that at some other stations the interference will persist in spite of the hardest work to get rid of it. If it becomes necessary, the "balanced primary" method may be tried as a last resort; in this arrangement a small extra antenna is erected near the power lines and connected to ground through a second primary which opposes the effects (on the secondary) of the regular primary coil connected to the regular receiving aerial. This more complicated circuit may prove worth while, since, by its use, the noises have, in some cases, been almost entirely cut out after the simpler plans failed.

A Crystal Detector

THE main advantage of this detector is that a great number of sensitive spots on the crystal are obtained. A coherer-stand may be used, by substituting



A great number of sensitive points on the crystal are obtained

small galena crystals for the filings. In the absence of a coherer-stand, use two large binding posts, two brass rods and a piece of glass tubing which will fit snugly over the brass rods. The mineral is prepared by placing a sensitive piece of galena in a small piece of cloth and then pounding the crystal into small pieces. The small crystals are then separated from the powdered mineral, and placed in the glass tube . Adjust the detector by turning the glass tube and moving the brass rods until the maximum sensitiveness is obtained. A buzzer is used to excite the circuit in order to secure the best adjustment easily. Great care should be taken not to touch the crystals with the hands, since moisture or grease will decrease their sensitiveness to a great extent.

Restoring Electric Light Bulbs

OFTEN when the electric lights of the tungsten filament type go out, or burn out, it is caused by the breaking of the filament wire. When this is the cause, screw the bulb into the socket of a flexible cord and turn on the current. By holding the bulb in a horizontal position, manipulate it by turning and rolling and tapping it with the hand to cause the filament wires to cross. When successful it will instantly light While lit, hold it in a quiet position for a few minutes till the wires weld, after which it can be used for regular service.

The writer has been able to recover over 60% of light bulbs he has tried, and they have lasted from three hours to three weeks.—JOHN HOECK.

The Tuning of Radio Telegraph Receivers

By John Vincent

THE article of this series which appeared last month discussed the difference between free and forced oscillations in radio telegraph circuits, and applied the laws of resonance to several of the more common types of sending apparatus. It is interesting to note that the same simple fundamental laws of tuning govern the operation and adjustment of receiving apparatus, in very nearly the same way. The need of securing agreement in frequency between the arriving waves and the receiving aerial circuit is as great as the need of tuning together any two circuits involved in radio telegraphy.

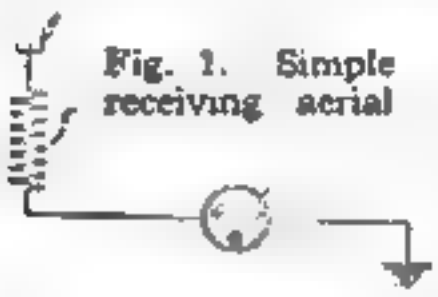


Fig. 1. Simple receiving aerial

As has been shown, the traveling electromagnetic wave which is sent out in all directions from a transmitting station has a definite wave-frequency. It is more usual to speak of each particular wave as having a particular *wavelength*, but it is just as accurate to consider the *wave-frequency*. The frequency of any wave may be found by dividing its length in meters into 300,000,000, according to the examples given in January. As has also been shown, every antenna circuit has a definite frequency of resonant vibration; this frequency depends upon the effective inductance and effective capacity of the entire antenna and connected instruments, and this frequency is that which would be assumed by an alternating current (or free oscillation) set up in the antenna system by first charging its capacity and then allowing it to discharge freely through the circuit to earth. The frequency of this free oscillation may be figured out, according to the rule given in the March article, when the capacity and inductance are known.

The frequency of free oscillation is practically the same as the frequency of the forced oscillation which will cause the largest current to flow in the antenna circuit. The equivalence of these two quantities, as explained in connection with transmitters last month, holds for receiving-circuits as well. In other words, the resonant free-oscillation frequency of an antenna system not only represents the wavelength which will be best radiated from that antenna, but also the wavelength which will be received with the greatest intensity.

This law may be worked out for a simple circuit arrangement such as shown in Fig. 1, where the antenna A is connected to earth E through a variable tuning inductance L_1, and a current indicator I. Suppose the instrument I is a sensitive hot-wire ammeter of the sort used in wavemeters, and that the aerial is rather large and is erected within a mile or two of a powerful transmitting station. Suppose that the antenna is of the flat-top variety, having four wires hung on 30′ spreaders and with a total length of 150′; this aerial will have a capacity of about 0.001 microfarad. If the high power sender is in operation, at a wavelength of 5000 meters, strong ether-waves of frequency 300,000,000 ÷ 5000 = 60,000 cycles per second will pass by the receiving station. If, now, we tune the receiving aerial to this frequency by adding to the coil L_1 until the total antenna inductance equals about 6.94 millihenrys, the ammeter I will show the greatest deflection. If either more or less than this amount of inductance is used, the current in the antenna will be smaller, for the reason that 6.94

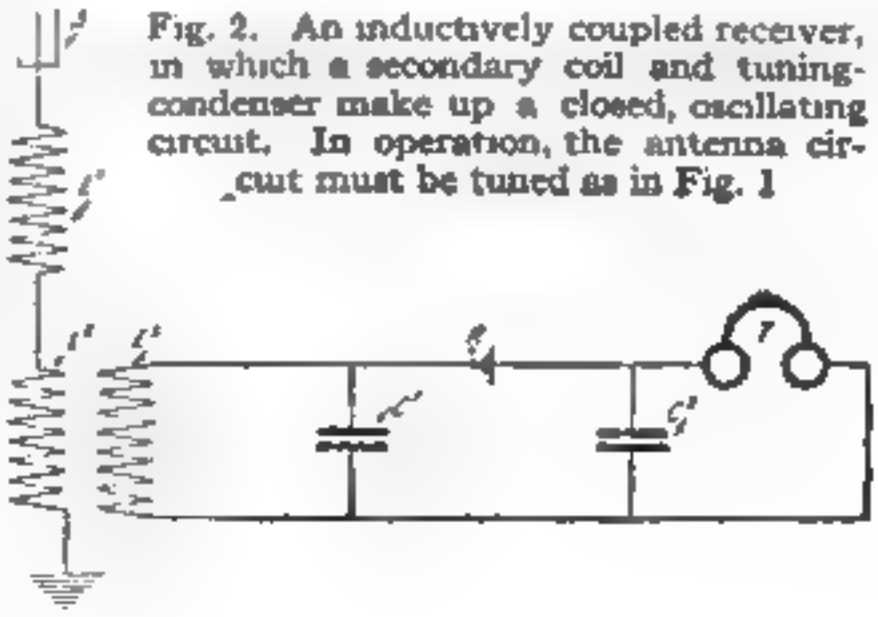


Fig. 2. An inductively coupled receiver, in which a secondary coil and tuning-condenser make up a closed, oscillating circuit. In operation, the antenna circuit must be tuned as in Fig. 1

millihenrys with the antenna capacity of 0.001 mfd. *tunes* to the wave-frequency of 60,000 cycles and therefore to the wavelength of 5000 meters.

The principle of tuning the antenna circuit, then, is to change its inductance or capacity or both in such a way and by such amounts that the resonant wavelength agrees with the length of the incoming wave. That is to say, the free-oscillation frequency of the circuit must be made practically the same as the frequency of the forced oscillations generated in the antenna by the received electromagnetic waves. These waves, of course, produce forced oscillations of their own frequency; hence it becomes necessary merely to adjust the antenna so that it will naturally radiate the wavelength which it is desired to receive.

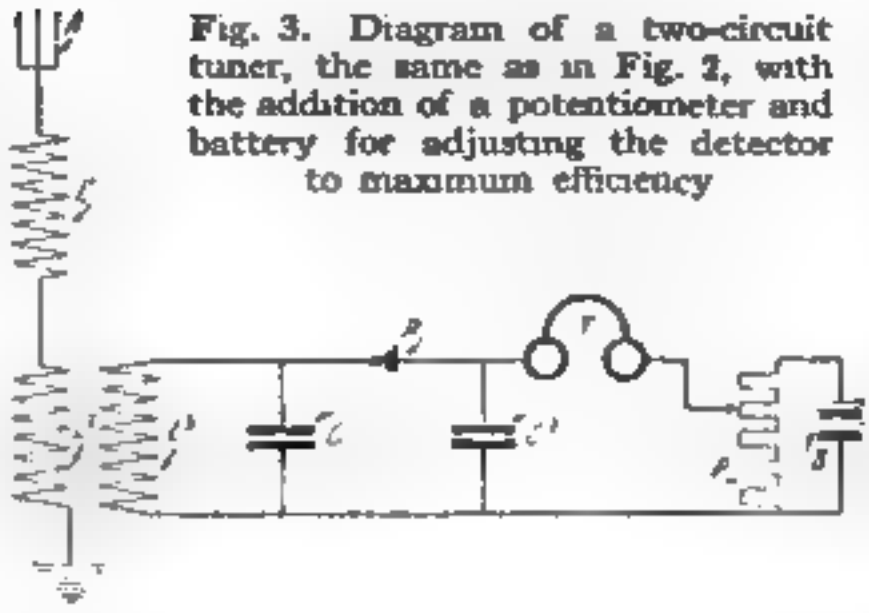


Fig. 3. Diagram of a two-circuit tuner, the same as in Fig. 2, with the addition of a potentiometer and battery for adjusting the detector to maximum efficiency

If a secondary circuit is coupled to the antenna, as in Fig. 2, the same general conditions apply. In this diagram the antenna A is connected to earth through inductance coils L_1 and L_2, as before. The lower coil is used as the primary of an inductive coupler, whose secondary is the third coil L_3. Across this secondary is connected a variable tuning condenser C_1, and in shunt to this the crystal detector R and the stopping-condenser C_2. This latter instrument has connected to its terminals the telephone receivers, T. In operation, the antenna circuit must be tuned to the frequency of the incoming waves by varying the inductance of L_1 or L_2, exactly as in the example just considered. If the antenna capacity is 0.001 mfd. and the incoming wave has a length of 5000 meters, the sum of the effective primary inductances must be about 6.94 millihenrys. A distribution which would agree with good practice would allow 0.05 millihenry for the antenna itself, 5 millihenrys for the loading-coil L_1 and the balance (1.89 millihenry) for the primary coil L_2. It would be entirely feasible to have the entire inductance of coils L_1 and L_2 in a single primary winding, but the convenience of a separate loading-coil for long waves makes it desirable to divide the coils as indicated.

The secondary coil L_3 and the tuning-condenser C_1 make up a closed, oscillating circuit of the kind discussed in the January article. In order to transfer the most power from the primary or aerial circuit to the secondary, so that the detector may be operated by the strongest impulses, it is necessary to adjust the time period of the secondary oscillation to agree with that of the primary. In other words, the secondary must have its inductance and capacity adjusted so that it is tuned to the wave-currents flowing in the primary. The resonant frequency of the secondary must be made the same as that of the primary, and the same as the frequency of the incoming wave. If the secondary coil L_3 has an inductance of 4 millihenrys, the condenser must be set at 0.00173 mfd. to give resonance for the assumed wavelength of 5000 meters. When the adjustment is such that the effective values of capacity and inductance are these, and when the coupling between the coils L_2 and L_3 is chosen so that the transfer of power is at the rate which is best for the detector in use, the loudest signals will be heard in the telephones.

The numerical values of inductance and capacity given in these two examples, it must be noted, are the *effective values* for the circuit considered. That is to say, the assumed frequency of oscillation will occur if the circuits behave as though these exact values of coil and condenser were used. The real measured values of capacity and inductance may be somewhat different (though not very much) from the quantities worked out by applying the simple rules; this is because the coils in the circuit react upon each other and partially destroy the pure inductive effect

of each, and because the simple capacity of the tuning condenser is not the only capacity in the circuit. For instance, in Fig. 2 it is necessary that the secondary effective capacity shall be 0.00173 mfd.; this is not the value of C_1 itself, since the capacity added by the presence of the detector, stopping-condenser and telephones must be considered. The capacity of the detector is very small and, since the stopping-condenser and telephones are in series with the detector, the resultant added capacity is still smaller. If, instead of the arrangement shown, the telephones had been connected across the detector, the limiting capacity would have been that of the 'phone windings, which is sometimes fairly large. A good reason for placing the telephones in shunt-to the blocking-condenser instead of in shunt to the detector is therefore brought out; the detector capacity is so small that tuning is governed almost entirely by the tuning-condenser C_1 when the arrangement of Fig. 2 is used.

A two-circuit tuner is shown in Fig. 3. It has all the elements as in Fig. 2, with the addition of potentiometer P and battery B for adjusting the detector R to its point of maximum rectification efficiency. The tuning to incoming waves is accomplished as in Fig. 2; the antenna circuit is first tuned by adjusting the inductances until its resonant frequency agrees with that of the waves desired, and then the secondary circuit is tuned to the same frequency by proper adjustment of inductance L_3 and capacity C_1. It should be noted that the same arrangement of telephones is shown here as in Fig. 2; the potentiometer, battery and telephones are connected across the stopping-condenser C_2 and not directly across the detector R, so that their capacity will not become prominent in the tuning of the secondary. This arrangement, as compared to the more common connection, gives greater ease of adjustment over a wide range of wavelengths, and makes sharper tuning possible.

The same principles of tuning may be applied to direct-coupled apparatus, as shown in Fig. 4. Here the primary and secondary are made part of the same coil, the proper amounts of inductance for each being tapped off by moving the sliding or switch-contacts as shown at L_2 and L_3. Obviously, the sum of L_1 and L_2 gives the amount of primary or antenna-circuit inductance, and the inductance of L_3 is that used in the secondary. To tune the secondary circuit to the desired frequency L_3 and C_1 must be used; L_1 and L_2 tune the primary. The coupling between primary and secondary is determined by the distribution of the total antenna-circuit inductance between the coils L_1 and L_2. For any given wavelength, the larger L_1 becomes, the smaller is L_2 (since it is necessary that their sum shall remain the same) and the *looser* the coupling between primary and secondary. The less of coil L_1 is used, the more of L_3 it becomes necessary to cut into circuit, and the *closer* the coupling. With a direct-coupled apparatus of this sort, having a separate primary loading-coil L_1, it is possible to secure as exact tuning as with the inductively-coupled apparatus; the bad reputation of "two-slide" tuners, as to dullness of tuning, has arisen mainly because the coupling is so tight that only broad tuning can be had when all the primary inductance is directly part of the coil which also forms the secondary.

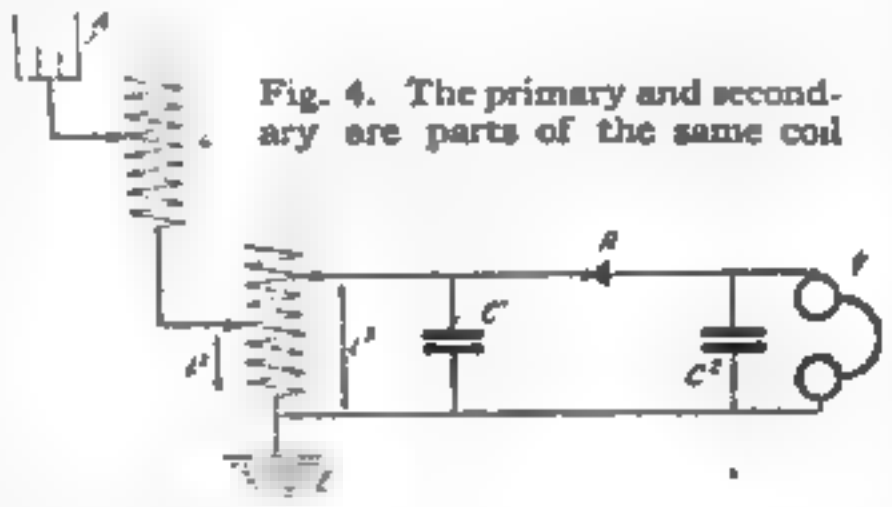


Fig. 4. The primary and secondary are parts of the same coil

In many cases it is not necessary to have as sharp selectivity as may be secured from the circuit of Fig. 2; in these instances the secondary tuning condenser C_1 may be dispensed with, as shown by Fig. 5. Here the primary L_2 and the loading-coil L_1 are adjusted as usual to the wavelength which it is desired to receive; the secondary is so broadly tuned, however, that it is not necessary to regulate its inductance by small amounts in order to secure loud

signals. If a single-pole switch is placed in the lead to C_1 of Fig. 2 (as shown in Fig. 1 of p. 306 in the February issue) it becomes possible to use either the broad or the sharp-tuned secondary system, as may be desired. For any given wavelength more inductance on the secondary will be required to get loud signals with the arrangement of Fig. 5, than for Fig. 2; this is because the secondary circuit of Fig. 5 actually is broadly tuned by the capacity of the detector, blocking-condenser, telephones, etc., acting with the total inductance of the secondary. Since the natural capacity of these other elements is small, a larger secondary inductance is made necessary to reach the desired wavelength.

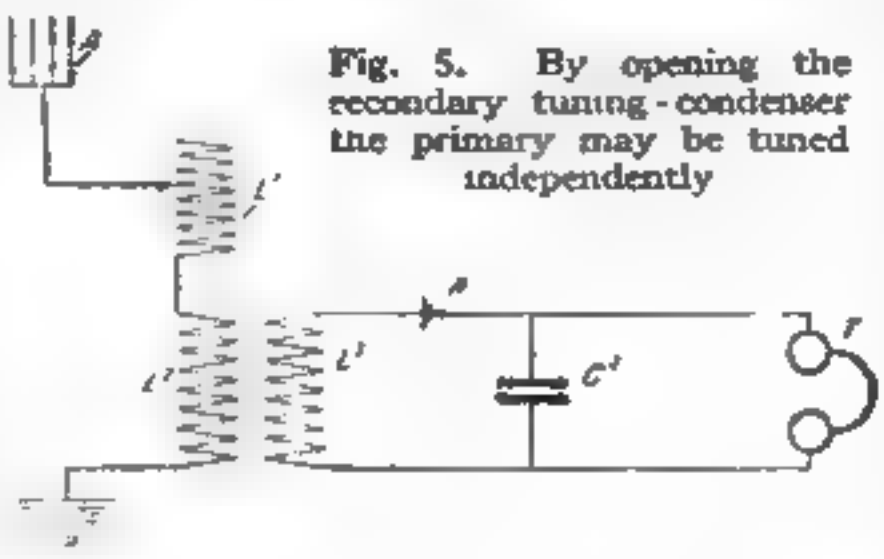


Fig. 5. By opening the secondary tuning-condenser the primary may be tuned independently

Where still less closeness of tuning is necessary, the arrangement of Fig. 4 may be modified by omitting the loading-coil L_1 which permits variation of coupling, and by doing away with the tuning-condenser C_1, as shown in Fig. 6. This results in the ordinary close-coupled direct tuner, which is useful for picking up signals when interference is not severe. By connecting in the tuning-condenser C_1, as shown by the dotted lines, it is possible to improve the selectivity of the system in some measure, especially if the blocking-condenser C_2 is made of very small capacity or even left out altogether.

It will, of course, be seen at once that in tuning the secondary circuit of any of the receivers described above, one may choose a great many combinations of inductance and capacity in order to have resonance to a certain frequency. For instance, the wavelength of 5000 meters is reached when the secondary inductance is 4 millihenrys and the condenser 0.00173 mfds. If the inductance were 2 millihenrys, twice the former capacity, or 0.00346 mfd. capacity would be required. The best ratio of inductance to capacity depends largely upon the type of detector used; for most crystals, the condenser may be about 0.003 mfd., maximum for wavelengths from 1000 to 5000 meters, and correspondingly smaller or larger for shorter or longer waves. For the audion, where the highest possible voltage should be applied to the grid, it is best to use comparatively large values of secondary inductance, with the corresponding small secondary condensers; C_1, for audion working, had best never be larger than 0.001 mfd., even for the longest waves.

The size of the stopping-condenser C_3 is also a matter of interest. For crystal detectors, it is customary to use capacities of from 0.01 to 0.04 mfd. at this point in the circuit. By making the stopping-condenser variable in steps of about 0.005 mfd., it is possible to select a best value for each particular operating condition; in general, the higher the telephone resistance and the higher the incoming spark-frequency, the smaller the stopping-condenser may be. The smaller this condenser is made, after it passes below about 0.01 mfd., the less is the damping of the secondary circuit, and the sharper is the tuning. Too great reduction of the capacity, however, in the attempt to gain selectivity, results in weakening the response to the signals. The size of the blocking or grid-circuit condenser for the audion is much less than for the crystal detectors; C_2 is then best made variable, with a range including values as small as 0.0001 mfd. or less.

In operating any of the sharply tuned circuits shown in the foregoing, it must be remembered that the best settings of primary inductance, coupling, and secondary inductance and capacity are largely dependent upon each other. In tuning-out interference and "bringing in" a particular station, the best plan is first to open the secondary tuning-condenser circuit to give the arrangement of Fig. 5; this makes it possible to tune the primary independently and ac-

curately to the inductance value which gives the loudest signal when the coupling is made fairly loose. This primary adjustment is then left fixed, and the condenser C_1 cut into circuit to tune the secondary. By selecting the best setting of C_1 in connection with several values of L_2, one particular value which gives the best signals is found. This is left fixed, and the coupling is gradually opened. For each looser position of coupling, the primary inductance and the secondary tuning condenser are varied slightly, to the point which gives loudest signals; thus a final adjustment is found which gives either (1) the loudest possible signals from the desired station, or (2) readable signals with a minimum of interference.

How to Build the Mast for a Wireless

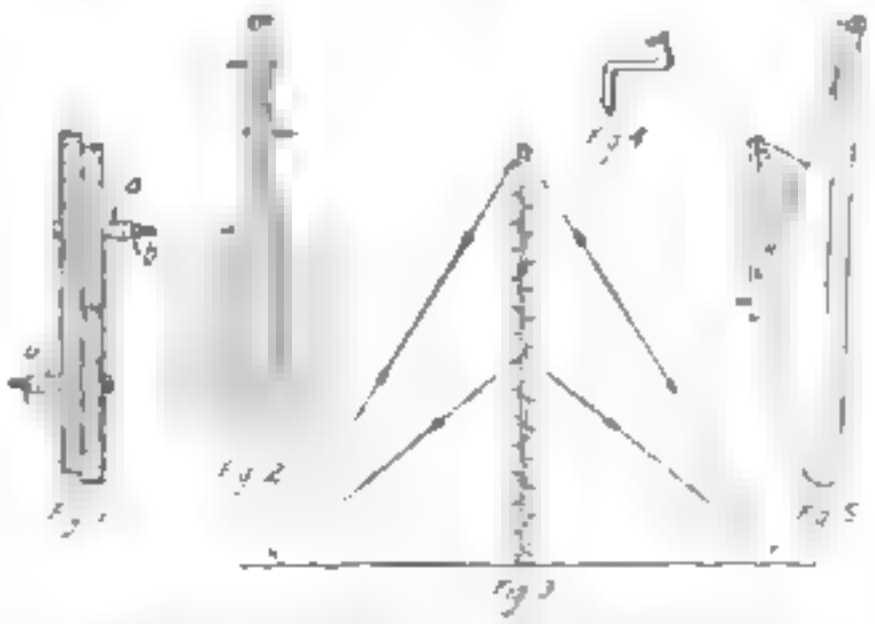
THE person who wishes to install a wireless station can easily find ample directions. When it comes to a support for his aerial, however, it usually says to erect a mast sixty to ninety feet high, without giving the details of its construction. Following are the materials needed for a mast sixty feet high:

10 pieces, 12′ by 2″ by 4″, straight-grained hemlock.
2 pieces, 4′ by 2″ by 4″, chestnut.
1 ½-inch bolt, 10″ long.
29 ½-inch bolts, 8″ long.
116 blank nuts to fit on ½-inch bolts.
120 ft. of rope.
2 pulleys; also guy wires and insulators.

The first thing to consider is the foundation. This is made of two 4′ chestnut pieces, shown at *a* Fig. 2. The durability of the wood may be increased by applying a coat of tar paint. Bore a ½-inch hole in each timber 3′ from the end. Nail a block *b*, 4″ thick, between the other ends; this holds the pieces the proper distance a part. Dig a hole where the mast is to be erected and place the wooden pieces in it, with the block at the bottom. Allow the ends to project 8″ above the ground, which should be stamped down very firmly to insure stability.

For the mast proper, saw one of the 12-foot pieces in half. Lay one of the halves on top of a 12-foot piece so that their butts are even at one end; and 3″ from their butts bore a ½-inch hole through both. Bore another ½-inch hole 3′ from the butts; then one every 2′ along the whole length of the mast.

Bolt the one 6-foot piece and the three 12-foot pieces together. The bolt is slipped through the holes, four blank nuts put on the bolt and then a threaded nut screwed on. The blank nuts are designated by *a* and the threaded one by *b* in Fig. 1. This 24-foot section is laid so that its butt can be bolted to the foundation with a ½-inch bolt 10″ long, as in Fig. 2. Before raising this section, drive a 6-inch spike bent as shown in Fig. 4. Thread a pulley with rope and hook it upon this spike. The tackle will then be in place when the section is raised. After raising the 24-foot section to a vertical position and guying it temporarily, drive a 6-inch spike into the end of a 12-foot timber, after bending the spike as shown in Fig. 4. Then hook the second pulley *c* on the spike, Fig. 5. The end of the rope from pulley *b* is tied to the piece a few inches from the center. The reason for this operation will be made clear by examining Fig. 5. Each time a 12-foot piece is raised, the tackle is always raised for the next timber. When in position, each piece is bolted to the one raised before, and so on to the top. Two sets of permanent guys are attached to the finished mast, as indicated in Fig. 3, one set being 30′ and the other 60′ from the ground. The guys should be insulated every 30′.—E. R. Thomas.



Construction details of the wireless mast

Construction of Unipolar Dynamos

THE direct-current dynamo, as pictured by almost everyone, is a complicated machine having many poles and an iron armature which is wrapped up with many turns of copper wire and which has at one end a huge copper commutator on which copper or carbon brushes bear gently, to conduct the energy to distributing wires and cables. Very few, however, realize that there is another type of direct-current machine which, although suitable, as yet, only for some special uses, may eventually earn an important place for itself. This machine is the unipolar dynamo.

In the old style dynamo, the current

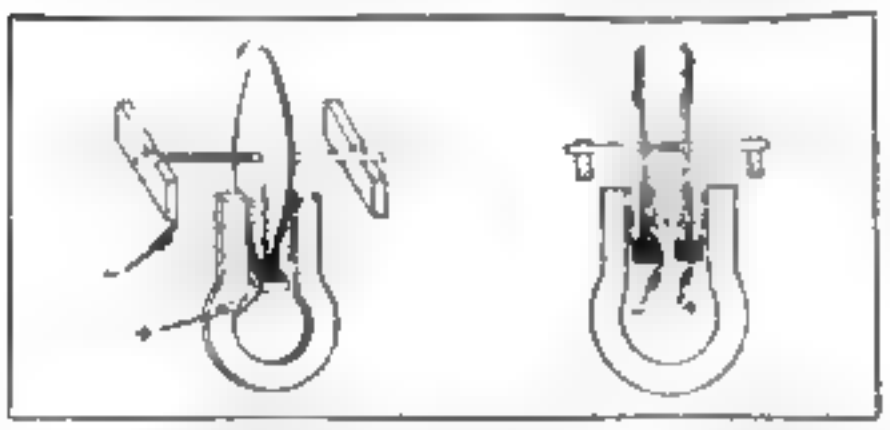


Fig. 1. Barlow wheel acting as a current generator

Fig. 2. Two wheels that revolve in opposite directions

set up in the armature windings is alternating, because the conductors, as they revolve, pass successively under a magnetic north pole and then under a south pole. In order that direct current may be delivered to the line, an expensive and delicate commutator is required, which reverses the connections with the line every time the current begins to flow in a direction opposite to that in which it was flowing before.

If arranged so that the armature conductors, as they revolve, cut across a magnetic field always in the same direction, the current generated will always flow in the same direction, and no commutator will be required. This arrangement has received the name of unipolar dynamo.

The most practical form of unipolar generator in use is, to a certain extent, a reproduction of the apparatus known as the Barlow Wheel (Fig. 1). It consists of a metal disk mounted so that it projects between the poles of a magnet. Connections are made to the shaft of the wheel and to the periphery of the disk by means of sliding-contacts. These contacts can be compared, in some respects, with the brushes of multipolar dynamos. If, now, the disk is rotated, the lines of force passing through it from pole to pole will be cut, and if the sliding-contacts are connected together, an electric current will flow in the circuit so formed. The disk is equivalent, electrically, to a large number of radial conductors connected in parallel, and hence, the voltage of the machine is the same as that obtained from a single conductor only; however, on account of the very large cross-section of the disk, the machine can supply a very large amount of current. It is evident that in the construction just described, the disk always cuts the lines of force of the magnet in the same direction, and hence the current supplied by the machine is direct and absolutely continuous, showing no pulsating effects.

It is known that in order to induce a tension of one volt in a conductor moving across a magnetic field, the conductor must cut one hundred million lines of force per second, and from this, it is evident that in order to have a unipolar dynamo delivering current at a high tension, it is necessary either to use a very large disk and magnet, or to rotate the disk at an abnormally high speed. Two or more disks, connected in series, can be used also, but in that case, adjacent disks must either be rotated in opposite directions, as shown in Fig. 2, or insulated from the shaft and connected by means of sliding-contacts. Adjacent disks may also be connected with the shaft, revolved in opposite magnetic fields (Fig. 5), and connected together by sliding-contacts on their periphery; for, if the conductors connecting the disks were revolved with them, an electric force would be induced in

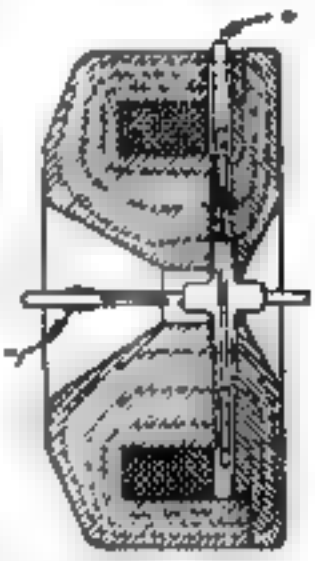


Fig. 3. Unipolar dynamo with one disk

them, equal, and opposite to that induced in the disks, so that the total voltage of the machine would be that of one disk only.

The development of the seam-turbine, however, has opened a large field to the unipolar dynamo, by providing a simple means for obtaining very high rotative speeds, although there is as yet one inconvenience to this coupling, i. e., sliding-contacts that will operate well at the high peripheral speed of the turbine-driven disk, which speed is as high as 80,000 feet per minute in the small-sized machines direct-coupled to a De Laval turbine. In connection with this, it must be remarked that commutator sparking is always liable to occur when ordinary turbo-generators are used, whereas this inconvenience is entirely eliminated with the unipolar dynamo, there being no commutator.

Figs. 3, 4 and 5 show the essential parts of three different types of unipolar dynamos, and of these types, the first and last are the most efficient, since no gears are needed, the wheels being keyed to the same shaft. The magnet of the Barlow Wheel is displaced by powerful electromagnets almost entirely covering the surfaces of the disks, thus creating a very large magnetic field for the armature to revolve in at high speed. The short arrows in these three figures indicate the path followed by current when the dynamos are in operation, while the dotted lines show the direction of the lines of force set up by the large coil forming the electromagnet.

In the construction of unipolar dynamos, the voltage of the machine is practically the only electrical point to be considered, inasmuch as mechanical considerations, stiffness for example, compel the designer to give the disk sufficient cross-section to carry a large current. For instance, with a single-disk, unipolar machine, required to give 50 volts at the terminals at 20,000 r p.m., a steel disk 16″ in diameter cutting across a magnetic field of a density of 95,000 lines of force per square inch, would be sufficient, and for that speed and diameter, a disk not less than ¼″ thick at the periphery would be required to avoid its bending. Such a disk, with eight sliding-contacts, can safely carry 400 amperes, yielding an output of 20 k w.

In unipolar dynamos, the main electric losses are those due to the resistance of the disk and that of the magnetizing coil; for the lines of forbe being always cut in the same way, hysteresis and eddy-currents are practically cast out. This is a great advantage over the multipolar dynamo, since with a high speed, the reversals of flux are very quick, and the hysteresis losses are large. Magnetic leakage is very much less important with a unipolar than with a multipolar generator. In fact, there is no need to consider it when figuring out the magnetizing windings.

Inasmuch as the disk-armature, if made of steel, can be very accurately faced and mounted, and is a good con-

HIGH SPEED GENERATORS

Peripheral speed between 40,000 and 60,000 feet per minute.
Air-Gap density, 95,000 lines per square inch.

RATING K.W	NORMAL VOLTS	NORMAL AMPS.	NO. OF DISKS	LENGTH OF AIR-GAP	DIAM. OF DISK	PERIPHERAL SPEED	R. P. M
10	25	400	1	[illegible]″	16″	41 900	10,000
20	50	400	2	[illegible]″	16″	41 900	10,000
30	50	600	1	[illegible]″	21″	56,100	10,100
100	100	1000	1	[illegible]″	44″	46,500	3 700
200	200	1,000	2	[illegible]″	48″	46,500	3 700
450	300	1500	2	[illegible]″	60″	55,000	3 500
750	500	1500	4	[illegible]″	60″	45 500	2,900

LOW SPEED GENERATORS

Peripheral speed between 15,000 and 25,000 feet per minute.
Air-Gap density, 95,000 lines per square inch.

RATING K W	NORMAL VOLTS	NORMAL AMPS.	NO. OF DISKS	LENGTH OF AIR-GAP	DIAM. OF DISK	PERIPHERAL SPEED	R. P. M
10	20	500	1	[illegible]″	30″	15 700	2 000
30	50	600	2	[illegible]″	37″	18 200	2 200
100	100	1000	2	[illegible]″	48″	24 800	1 900
300	200	1500	4	[illegible]″	60″	15 950	1,200

ductor for the magnetic lines of force, the air-gap can be very short, thus effecting a large saving in the magnetizing current. At the same time, unipolar dynamos can be very much overloaded without danger of burning the insulation, as the magnetizing coil, the only piece that need be insulated, can be wound with asbestos-covered wire. Consequently, the temperature can rise as high as necessary to carry a big overload for a long time, this overload being limited only by the capacity of the prime-mover, in the case of a shunt-wound generator. This is a great advantage over multipolar dynamos, as in these, cotton-and-shellac insulation is so profusely used, that a comparatively slight overheating is sure to injure the windings.

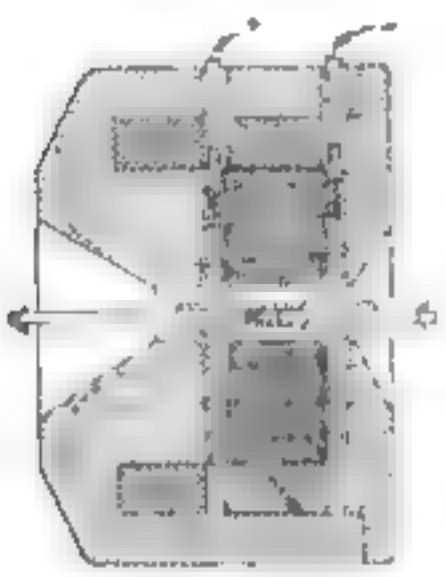


Fig. 4. Unipolar dynamo with two disks revolved in opposite directions

The table on page 625 furnishes some idea of the relations of size, voltage and output of the most efficient types of unipolar dynamos.

The only serious drawback of the unipolar dynamo is the low voltage that it supplies, but on account of the simplicity of the construction, several machines can be connected in series, or a machine with several disks can be used, and then the voltage delivered is large.

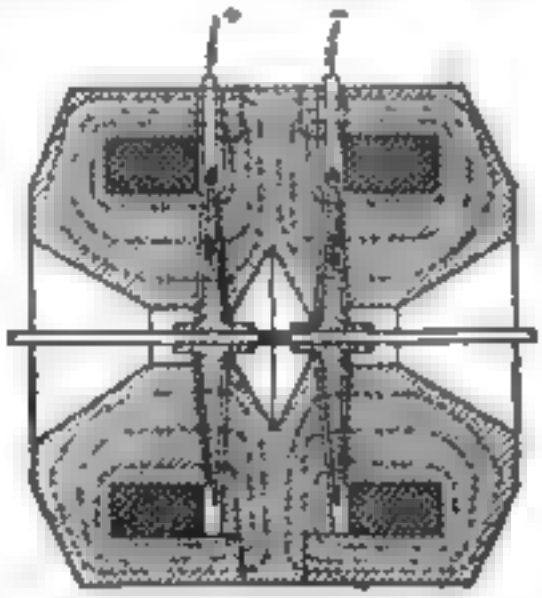
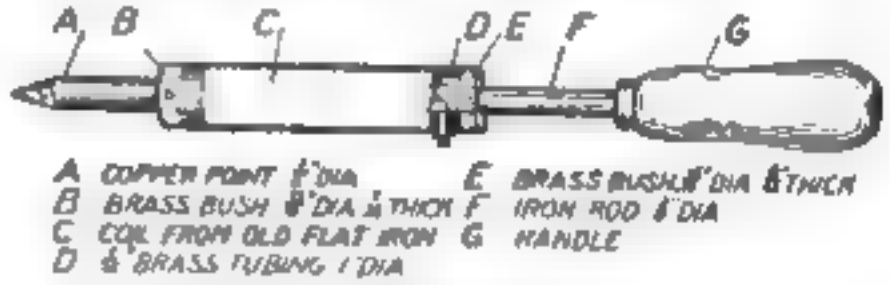


Fig. 5. Unipolar dynamo with two disks revolving in the same direction in opposite magnetic fields

The unipolar turbo-generator presents, as a whole, the most compact and efficient equipment known. The turbine is economical, and the unipolar requires no gears to be coupled to the turbine, and so receives the whole turbine power.

An Electric Soldering Iron

AN electric flatiron may be used in making an electric soldering copper by removing the coil and fitting over it a piece of brass tubing, 1″ by 5″. Cut a slot in one end to receive the plug contacts, and into the same end fit a handle in a bushing; into the other end fit a bushing holding a copper point. The plug from the flatiron may also be used, and can be quickly separated from the soldering tool—S. Bernstein.



The coil from an old electric flatiron is used in making the heating element of this electric soldering iron

Storage Battery Hints

SINCE the introduction of the electric starting and lighting for automobiles, hundreds of thousands of people have become acquainted with storage batteries, while the expansion of the field of electric passenger automobiles and trucks has brought thousands of storage batteries to garages for charging and overhauling. Charging a storage battery is not the simple thing it may seem, and much damage is done to batteries by careless handling. A few simple instruments, designed to remove all guesswork from charging, have just been brought out by a Philadelphia concern. They are as follows:

A rubber bulb-syringe for filling and equalizing the acid in the batteries.

A pocket thermometer, graduated from 20 to 220 degrees Fahr., especially designed for use in batteries while charging. The temperature of a storage battery should never be permitted to rise too high.

A hydrometer syringe, containing a hydrometer graduated especially for such work. The sharp point of the syringe is inserted in the storage cell opening, and the central portion of the syringe filled with the liquid. The hydrometer inside the glass cylinder will indicate the state of the battery: 1300 stands for fully charged; 1275 for 75%; 1250 for 50%; 1225 for 25% and 1200 for exhausted.

What Radio Readers Want to Know

A Tikker Receiver and How it Works

C. M , Indianapolis, Ind., inquires

Q. I should like some information concerning the "tikker" for the reception of undamped oscillations. I have heard considerable regarding continuous waves but so far have not been able to ascertain just how a tikker is constructed.

A. However constructed, the tikker is nothing more than a circuit interrupter arranged to open and close some portion of the receiving tuner circuits at a rate of 200 to 500 times a second. The original Poulsen tikker consisted of two light gold wires, one of which was attached to the vibrating member of an ordinary buzzer which, when set in operation, interrupted the circuit from the secondary winding of the receiving tuner to the telephones. At a later date another form of tikker was devised which consisted of a toothed wheel driven by a small motor and in contact with a brush.

The very latest type of tikker is known as a "slipping-contact detector." Of simple construction, it comprises merely a grooved wheel (with a perfectly smooth surface) rotated at a speed of say 1000 revolutions per minute. A small piece of thin steel wire is placed in light contact with the groove. The constant gripping and slipping of the wire during rotation causes a variation of the accumulated energy in the telephone condenser, thus setting up audible pulses of current in the telephone circuit.

The tikker, regardless of the type of construction, occupies the same position in the secondary circuit of the receiving tuner as the crystal detector, but generally the secondary winding is constructed of Litzendraht to give a circuit having a minimum value of damping.

Range; Aerials; Quenched-Gap

D. P. D., Limon, Colo., asks.

Q. 1. Will an aerial 100 ft. in length by 50 ft. in height be satisfactory for receiving messages from coast stations with 1000 to 1500 miles of mountainous country intervening? The local conditions for this work are good, since there are no high buildings or hills in the immediate vicinity. This aerial will have an altitude of 5600 ft. above the sea level. Will I be able to receive ship stations with it?

A. 1. If receiving apparatus of the vacuum-valve amplifier type is installed little difficulty should be experienced in receiving signals from the coast stations during the night hours.

Q. 2. Does a series condenser cut down the sending distance of a transmitting set?

A. 2. Speaking generally, it has the effect of cutting down the flow of current in the antenna system and therefore reduces the range. The insertion of a series condenser generally has the effect of increasing the total resistance of the antenna system.

Q. 3. Will an aerial 50 ft. in length by 40 ft. in height, composed of 4 wires spaced 3 ft. apart, be satisfactory for transmitting 100 miles using a. 1. k. w. closed-core transformer and a rotary spark-gap?

A. 3. It will be rather difficult to consume the full output of this transformer at a wavelength of 200 meters because the capacity of the condenser cannot exceed 0.01 mfd. If the receiving station is fitted with suitable apparatus you will experience little difficulty in covering the desired distance at nighttime. During the daylight hours we should prefer a 2 k. w. or 5 k. w transmitting set operated at an increased wavelength.

Q. 4. Which is considered the more efficient, a rotary-gap or a quenched-gap when the necessary high potential is obtained from the 1 k. w. transformer?

A. 4. The quenched-gap may be made the more efficient electrically, provided the transmitting apparatus is harmoniously designed throughout. A well-designed quenched-gap transmitter has a specially constructed motor generator and transformer. The range of the average amateur station will be increased by the use of a quenched-gap provided certain precautions in the design of the apparatus are observed. For example, the oscillation transformer should be so constructed that the inductance value of the primary and secondary windings can be regulated inch by inch. Likewise the degree of coupling between the primary and secondary windings must be very closely adjustable.

The potential of the transformer requires careful regulation. In motor generator sets this is accomplished by means of the generator field rheostat, but where the energy is taken direct from the city mains it may be necessary to supply a transformer having variable tap-offs in the secondary winding, in order that the correct value of voltage may be obtained. In addition, the high potential transformer must be one that possesses considerable magnetic leakage If of the closed-core type, it should be fitted with a magnetic leakage gap. The open-core transformer naturally possesses this characteristic If you are not wholly familiar with the design and requirements of the quenched-gap discharger, the rotary-gap is recommended on account of its simplicity, easy construction, and permanence of adjustment.

Induction from Streetcars

F. M., Washington, Ind., writes:

Q. I am about to purchase certain wireless telegraphy instruments, but inasmuch as my receiving aerial will be located near a streetcar line and powerhouse I desire to know what effect these wires will have on the reception of signals?

A. Although you may expect to receive interfering sounds from these wires due to electrostatic induction, they will not wholly prevent the reception of signals. If possible, place the receiving aerial at right angles to the power line.

Receiving-Tuner Doubts Cleared Up

W. B. H., Fresno, Cal., inquires:

Q. In the December, 1915, issue you give certain dimensions for an inductively-coupled receiving tuner to cover a range of 1500 meters. The statement is made that the primary and secondary windings should be made of No. 28 B. & S. fage copper wire. To me this seems incorrect. I cannot understand how the secondary voltage will be any different from that of the primary if the same size of wire is employed. Before commencing the construction of such a tuner I should like to have this matter cleared up.

A. It is perfectly feasible to cover the primary and secondary of the receiving tuner with the same size of wire. For the average crystal detector it is customary in some forms of commercial apparatus to use No. 32 S. S. C. wire on the secondary. A step-up ratio of turns in an oscillation transformer does not necessarily mean a stepping up of voltage, since there are other factors which must be taken into consideration. Please understand that the actual wavelength to which the tuner described in the December, 1915, issue will be adjustable depends upon the capacity of the condenser in shunt to the secondary winding. With a secondary winding 5 ins. in length by 4½ ins. in diameter, covered with No. 32 wire and shunted by a condenser of 0.001 m.f. capacity, the tuner will be adjustable to wavelengths in the vicinity of 4000 meters.

Where to Place Receiving Aerials

R. P. C., Nineveh, N. Y., asks

Q. I wish to construct an aerial 60′ in height by 200′ in length. Our buildings are surrounded by hills. In which location do you think I would achieve the better results for receiving purposes, namely, by suspension of the wires on 20′ poles atop of the barns which are 40′ in height, or by placing them on 60′ poles upon the hill, which is 200′ above the barns? Our elevation is 1145′ above the sea level. Approximately over what distance may I expect to receive messages?

A. For general work we should prefer to erect the aerial on the hill, provided that the receiving apparatus can be housed in the immediate vicinity of the aerial. The actual distance over which messages may be received depends entirely upon the type of receiving apparatus in use. With the average amateur equipment fitted with a crystalline detector you should be enabled to copy messages at nighttime during the favorable months of the year from all commercial stations located on the Atlantic coast and Gulf. With an extremely sensitive long distance set, say one employing a regenerative receiving circuit in connection with the audion, you should experience no difficulty in receiving messages from the radio station located at Nauen, Germany.

A Receiving-Condenser for 1500-Meter Loose-Coupler

W. M. K., Windsor, Ont., inquires:

Q. 1. I should like to put this department to trouble again by asking for information concerning the size of a receiving condenser for a 1500-meter loose-coupler. Approximately how many tinfoil sheets should be used and what are the required dimensions?

A. 1. We assume that reference is made to the fixed condenser in shunt to the head telephones. Two sheets of tinfoil 30 ins. in length by 2½ ins. in width, separated by a thin piece of paraffin paper and rolled up on circular form, will give a sufficient value of capacity for the average requirements. The variable condensers must be of the air dielectric type such as supplied by electrical supply houses advertising in the columns of this magazine.

Q. 2. Approximately over what distance can I receive with this set connected to an aerial 90 ft. in length and 50 ft. in height at both ends, keeping in mind that the tuner is adjustable to a wavelength of 1500 meters?

A. 2. During the nighttime this apparatus should be responsive to stations 1000 to 1200 miles distant. The daylight range is problematic.

Sustained Waves and Government License

H. W. D., Jr., Schnectady, N. Y., asks:

Q. 1. May an amateur make use of a set responsive to an undamped wave?

A. 1. There are no regulations governing the type of receiving apparatus employed at the amateur station. If an undamped oscillation transmitter were employed it would be necessary to secure a U. S. station license.

Q. 2. What is the fundamental wavelength of a four-wire aerial 120 ft. in length, 45 ft. in height at one end and 50 ft. at the other with a lead-in of 25 ft. placed at an angle of 70 degrees to the aerial?

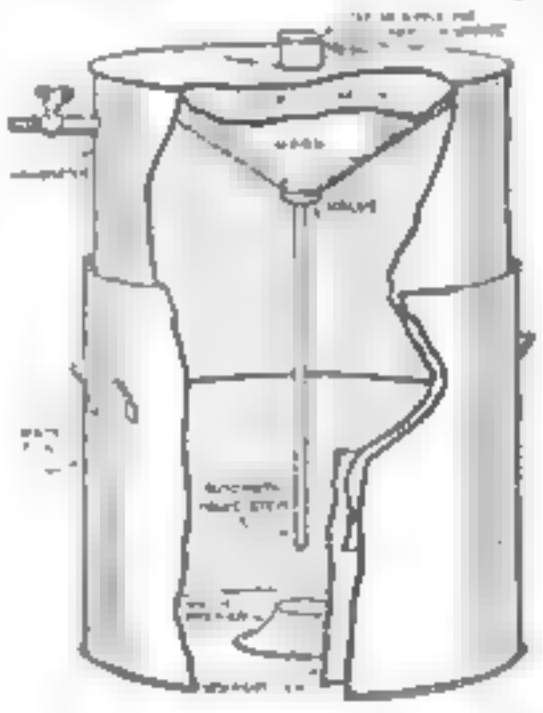
A. 2. The natural wavelength of this antenna is approximately 320 meters.

The Home Workbench

Making an Acetylene Gas Generator

THE gas generator used by the United States Life Saving Corps and also by the Volunteer Life Saving Corps for their searchlights on beach-wagons is not difficult to construct. Carbide about ¼ in. in diameter is used, and costs, retail, 10 cents per pound. Fifteen pounds will light a home three hours each evening for one month, at a cost of $1.50. For each pound of carbide a gallon of water is used. Hence to make a 15-pound carbide generator, a 15-gallon tank must be used. Only galvanized iron should be used, as it corrodes the least of any metal.

After deciding upon the size (say 15 pounds), take two 15-gallon tanks. Select one which will fit, inverted, inside of the other, allowing enough space to slide up and down without binding (see diagram). Another small tank, half the height, is used to catch the falling carbides. This holds the sediment, prevents it from spreading and simplifies cleaning Besides, it is the only tank which corrodes. To determine how large to make the hood, use 15 pounds of dry earth as a medium for measuring. Pile it in a cone, the width corresponding to the width of the tank. The height measurement gives the depth of the hood. A model of the hood should first be made out of pasteboard to avoid waste or error in cutting. It should fit snugly, inverted in the gasometer tank. Cut off the point of the hood to allow a 1-in. hole for a valve-opening. Lay the model flat on metal and draw around it, cut with shears, roll carefully around a pipe to get the shape, and solder together. A 1-in. flat washer is used, being soldered into the valve-hole on the inside to act as a guide for the valve-head when it is closed. A ¼-in. pipe soldered into a 1-in. cap for a valve-head and stem can be used, the length of the stem being 2 ins. longer than the gasometer (see diagram). Place the valve in position, solder the hood in the gasometer, and make sure there are no leaks in any of the tanks. If you are not sure of the tightness, turn both tanks upside down and test with water.



A government gas generator which is easily built by an amateur

In the top of the gasometer drill a 2-in. hole, solder in a nipple, and screw on a cap with a leather washer. This is used for filling the hood with carbide. A gas-cock is soldered in the side of the gasometer near the top for the gas supply, for the hose, or for the pipe to the gas line. A 1-ft. acetylene burner gives 100 candle power.

To operate the generator, fill the water tank with water and the hood with carbide. Close the gas-cock and place the gasometer in the water-tank. Open the gas-cock to let the air out. The gasometer will sink very slowly until the valve-stem touches the bottom, thus opening the valve and letting the carbide escape into the inner tank and generate gas. The gas will raise the gasometer three-quarters of the way up, and thus

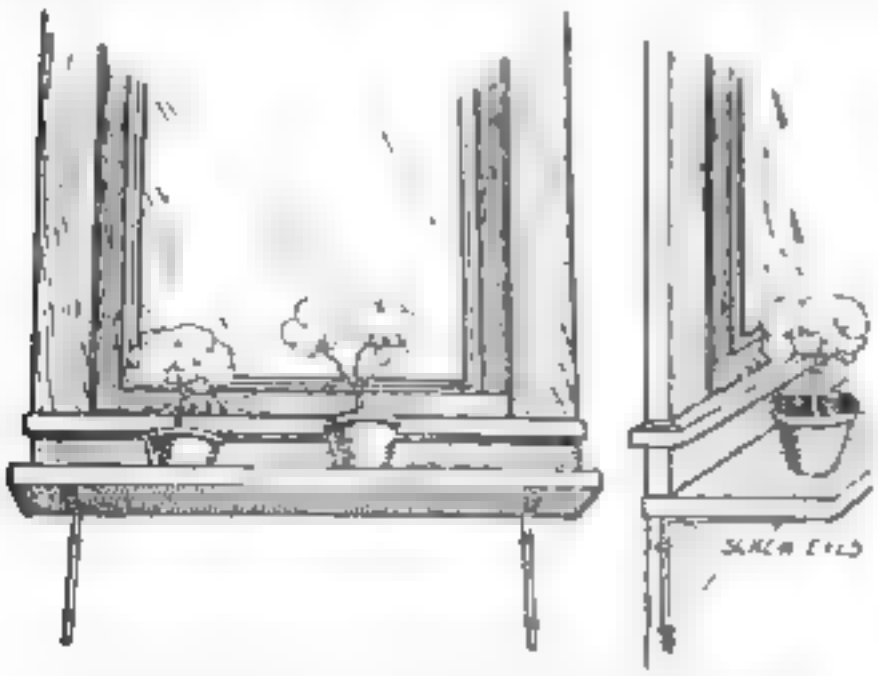
close the valve automatically. Close the gas-cock, make the proper connections, and the apparatus is ready to use. As gas is consumed, the gasometer descends until it opens the valve. More carbide falls into the receptacle to generate fresh gas, thus raising the gasometer and closing the valve again. When through with the light, turn off the gas-cock. This stops the generator. As the gas cannot escape, it remains in the same position until used again.

The gas is generated in the larger tank, rises to the smaller tank and lifts it. The weight of the gasometer prevents it from going too high and also gives the pressure to the gas. The gas cannot flow down and around and out through the spaces between tanks, since the quantity of water forms a perfect seal.—T. F. Buscu.

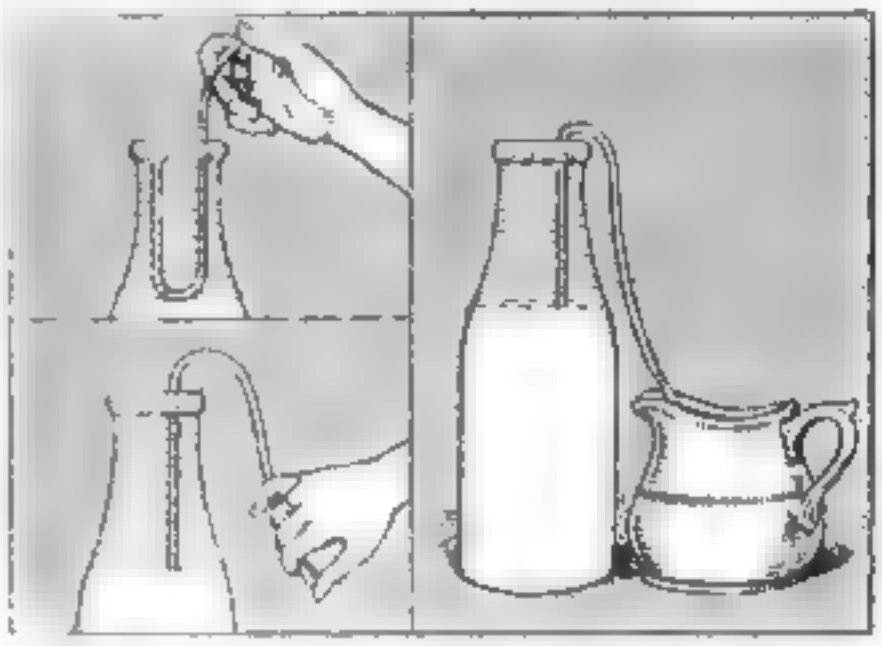
A Novel Window-Shelf

PROCURE from a blacksmith two ⅜″ iron rods about 16″ in length. Bend these in the center at a right angle. Then put eight ordinary screw-eyes—the eyes must be large enough to permit the rod to pass through—into the wall and into the under-side of the shelf-board as the illustration shows. With a pair of pliers open up the eyes of those in the wall, which is an easy matter. Now insert the rods and bend the eyes back over them. The shelf-board can now be slipped on the projecting ends of the rods, care being taken that they go through both the front and rear screw-eyes. Unless the screw-eyes are long enough to be driven into the scantling, supporting upright strips for these will be necessary.

When it is desired to remove the shelf-board to facilitate sweeping, for instance, just pull it out and swing the ends of the rods back against the wall as if they were on hinges. They may even be removed if desired.



Two views of a simple window-shelf which can be easily removed

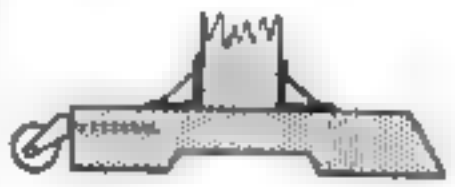


The cream may be taken off the top of a milk bottle with a syphon more rapidly and effectively than with a spoon

A Siphon to Remove Cream from Bottles

AN easy and effective means of removing the cream from bottles of milk is shown in the illustration. The siphon is filled by inverting the short end in the neck of the bottle until the cream runs in; the thumb is then held over the long end and the siphon placed in position. By adjusting the depth to which the short end reaches in the bottle, the entire amount of cream can be removed without withdrawing any milk. The siphon is easily cleaned by running hot water through it. An ordinary rubber tube will do.

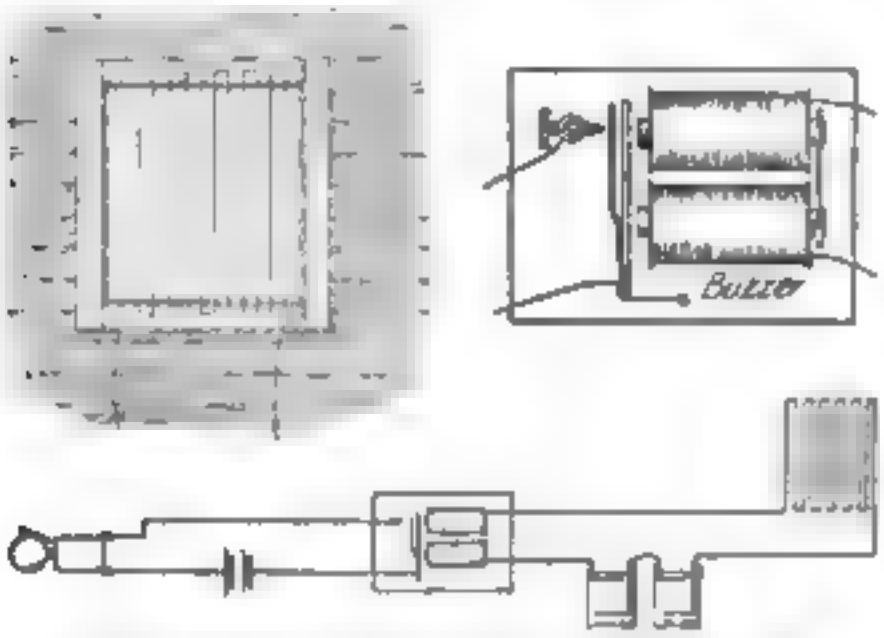
A Wash-Wringer Attachment



TO facilitate the moving of the wringer to and from the wash-room, saw off one end of the bottom at right angles, drill a hole in it, and fasten on a caster. The caster should be one of the type which does not pivot about and should be so placed that it barely touches the floor when the wringer is upright. When it is desired to move the wringer, pull it back on the caster and push it ahead.

A Burglar-Alarm for the Unprotected Chicken-House

CHICKEN-FANCIERS and poultry-farmers will be interested in an electric alarm which is set ringing by thieves. The favorite means of entrance, provided the door is securely locked, is through the windows of the coop. The installation of the usual type of burglar-alarm involves an outlay for costly equipment. The apparatus to be described is inexpensive, and may be easily installed.



When the chicken thief breaks the thin wires covering the window, he opens the circuit, the buzzer-armature drops, and the alarm bell rings

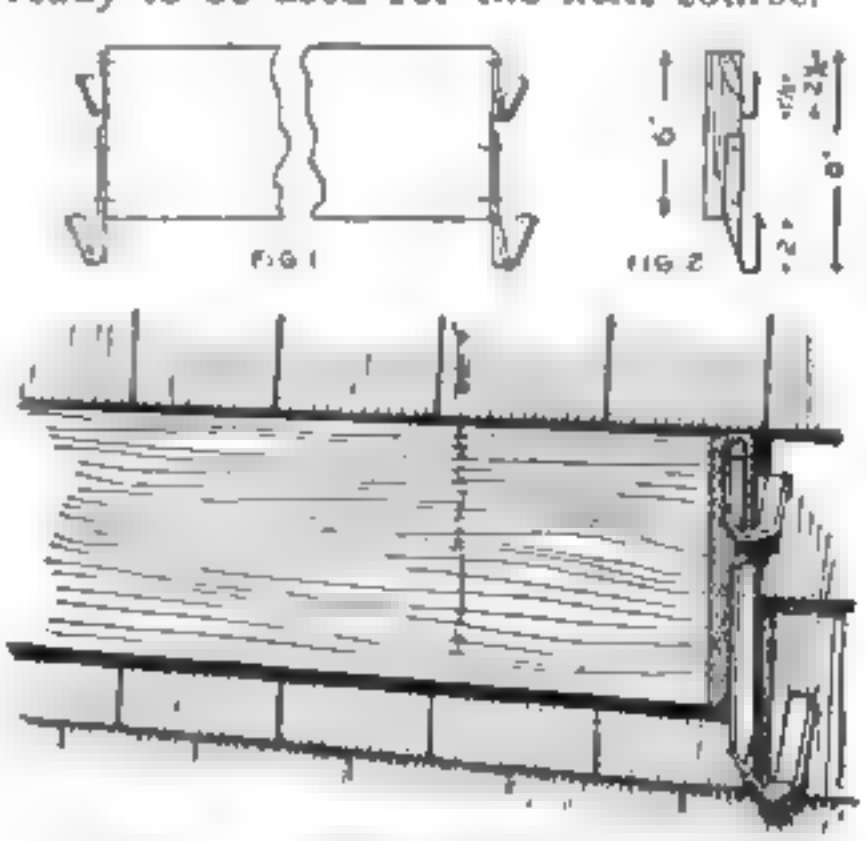
A row of wire nails about 1″ apart should be driven into the window-frame above and below. Fine cotton-insulated, magnet-wire should be strung up and down over the two rows of nails, as shown in the diagram. The two ends should be led to a gravity cell, and also to the magnets of a buzzer. The armature of the buzzer should be disconnected, but not removed, as it will have another use. By consulting the diagram of connection it will be obvious that if the wires over the window are intact, the armature will be drawn down upon the magnet-cores, away from the contact. Wires connected with a bell and dry batteries in the house—the distance makes no difference—should be brought to the armature of the buzzer and to the contact that touches it.

The operation is as follows: When a marauder attempts to enter the window, he breaks the wires—which he assumes to be strings—with a sweep of the hand. The circuit, suddenly opened, allows the armature of the buzzer to fall back against the contact. This closes the bell circuit and causes the bell to ring in the house. If there are several windows in the chicken-barn, the wires covering all of them should be connected in series. Gravity or blue vitriol batteries should be used for the magnet circuit.

How to Shingle Without Leaving Nail-Holes

THE illustration will show how a 1′ by 6′ straightedge, or longer, can be used to lay shingles 2½″ by 8″ or 2″ by 7″, according to the weather, on the side of a building, without nailing the straightedge on to the shingles and thus leaving unsightly holes. Any blacksmith will make four hooks out of ½″ by ⅛″ iron and twist them so that the shank can be screwed on the ends of the straightedge, and so that the hook part will extend down and under the last course of shingles, as indicated in Fig. 2.

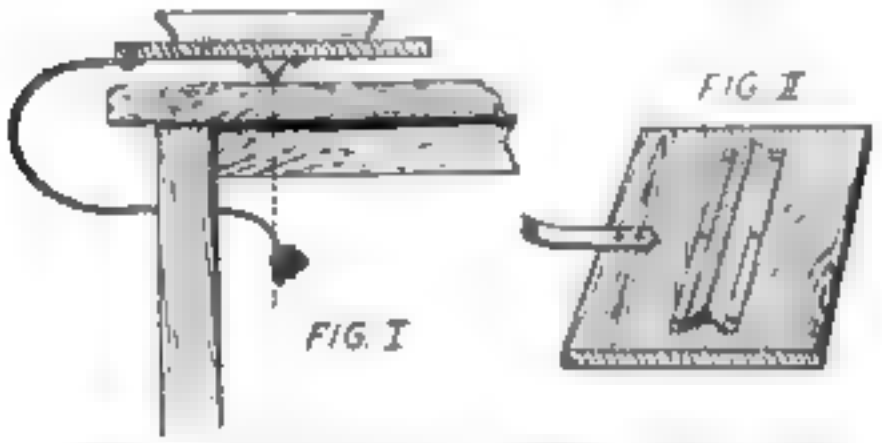
The iron is drawn out to 1/16″ thickness, and the spurs on the hook part are made by cutting a V in the hook while it is hot and turning it back and filing it down to a sharp edge. This spur holds the straightedge in place. It is well to have this part of the hook offset clear of the ends of the straightedge (Fig. 1). After the straightedge is in place, a slight tap of a hammer over the shingle will drive the spur into the shingle underneath. No holes will be left to mar the face of the work. A slight jerk will pull the spur out and the straightedge is then ready to be used for the next course.



Details of a shingling device which keeps the edges straight without driving nail-holes into the exposed ends

A Self-Rocking Developing-Tray

A SIMPLE form of mechanical rocker, which may be relied upon to keep up a steady, gentle movement for a long period without attention, is a great convenience to the busy photographer. A flat, square board, rather larger than the developing-tray, is pivoted on the apex of a zinc triangle, as shown in Fig. I. The zinc triangle is easily made from a strip of sheet zinc



The counterbalance swings under the table and the tray rocks easily and continuously without attention

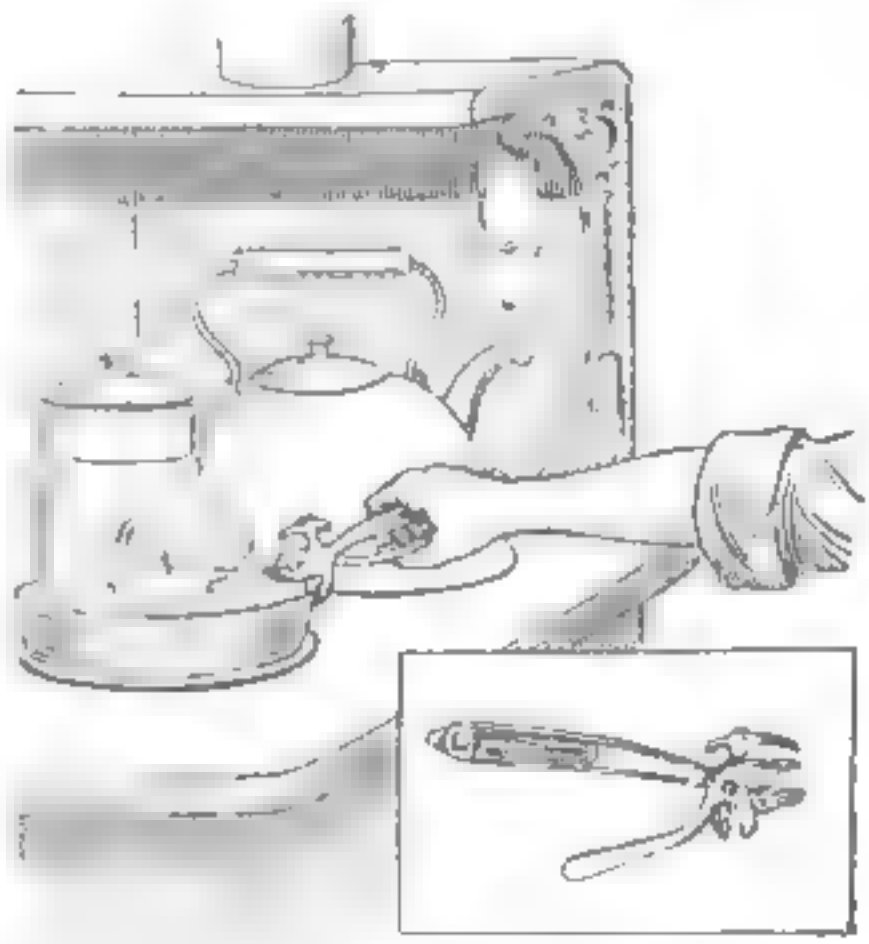
as long as the side of the board and bent into the form of a V, with flanges for attachment to the board. It should be screwed along the exact center of the under side. An alternative is to use a triangularly-shaped piece of wood, 1¼" thick, nailed through from above. The wood must, of course, be rather hard. A piece of strong, flat iron, 3′ or more in length, must be fastened at one end to the under side of the base, also in the center, but at right angles to the pivot. This is shown in Fig. II.

With the board standing on the edge of the table, the iron should be bent into a curve reaching under the edge of the table as illustrated. A weight of several pounds is firmly secured to the free end of the iron. This weight can be made by casting ten or twelve pounds of lead scrap into the shape of a disk, a hole being made through the center for bolting the disk to the arm. The disk weight must be fastened securely; else the movement will be jerky, and much energy will be lost. In bending the iron, it will be necessary to adjust it by degrees until the board is found to balance freely on the pivot and come to rest in a level position.

The rocker leaves the operator free to attend to other matters while development is proceeding. If it is desired to open the darkroom door, a sheet of cardboard should be laid on the dish, and a light-proof cover should be placed in position. A cardboard box slightly smaller than the board, makes a good cover, if lined with two thicknesses of black twill, with additional pieces at the corners. This rocking arrangement is a time-saver for any photographer.

A Whole Tool-Box in One Tool

THE day of the family tool-box may soon be a matter of past history if a device that is now on the market can do all that its manufacturers claim for it. The tool that threatens to do this revolutionizing is 10 inches in length and weighs 11 ounces. It can do everything that a variety of household tools can do and other things besides. Here are a few of the tools whose work it intends to accomplish: Hammer, lifter for hot pans and dishes, tack-puller, screwdriver, nut-cracker, box-opener, wrench, pliers, rule, measure and ice-chipper. It works automatically.



This "Jack-of-all-tools" may be used to lift a hot plate off the stove or to hammer the tacks in the parlor carpet

FULLY one-half of all the automobiles sold in the United States are bought by farmers and others living in rural communities.

mixture should be thoroughly stirred until it is uniform throughout. It may then be applied by brushing out to a thin coat on the new wood. The turpentine will serve to carry the paint into the pores of the wood and thus provide a good substantial bond. The paint, moreover, will dry rapidly to a hard surface which will provide a permanent foundation for subsequent coats. Upon the priming coat depends the success of the whole painting job. Even if the coat looks thin, the hiding power of the paint should be sacrificed in order to obtain this thorough penetration and hard drying.

When the priming coat has become thoroughly hard and dry, which, as a rule, will take at least three days, although a week is better, all the nail holes and other imperfections in a wooden surface may be closed up with putty. There may then be applied the second coat of prepared paint as it comes from the container, without the addition of any material except a small quantity of turpentine if the paint is heavy. One pint of turpentine to a gallon of paint is generally sufficient for this purpose. The turpentine will cause the second coat to dry with a semi-matt surface. After a suitable drying period, the third coat may then be applied. No turpentine or thinner should be added to the third coat of prepared paint, since it is desired to obtain a film rich in oil, that will dry to a high-gloss surface. When old surfaces are to be repainted, all loose, scaled paint should be removed and rough, checked surfaces lightly sanded with fine sandpaper. The work may proceed for new surfaces as for the second and third coats.

How to Paint Rooms

A few years ago the use of paint was largely confined to exteriors of buildings. Interior walls were often left bare. Discoloration and dampness followed. The modern method is to decorate all interior wall and ceiling surfaces with paints which are of a washable character. These paints may present either a flat and light-diffusing surface, or a high-gloss, enamel-like surface. The flat or high-gloss paints are obtainable in prepared form. Before applying such paints to plaster or cement-wall surfaces, a wash treatment with a 25% water solution of zinc sulphate is advisable, in order to neutralize the lime present in the wall. Later, when the walls are thoroughly dry, the paints should be applied in two or three-coat work. High-gloss paints should always be applied over an undercoat of flat paint. Light cream color and the very light shades of pink, green, blue or very light gray give the greatest amount of light reflection in a room.

What Paints and Painting Cost

Paste paints cost about $3.00 to $4.00 per gallon, while prepared paints sell for $2.00 to $2.50 per gallon. A paint in prepared form, ready for application, will cover from 300 to 1400 sq. ft. per gallon, depending upon the character of surface to which it is applied. On smooth iron surfaces, the greatest spreading rate is obtained, and on rough concrete surfaces, the lowest spreading rate. On wooden surfaces the average spreading rate is about 900 sq. ft. per gallon, one coat. In estimating the amount of paint required for a surface, the total number of square feet should be calculated by multiplying the width by the height, of each side. The total area should then be divided by 300, which will give approximately the number of gallons required to produce three-coat work. For instance, if the total area for the four sides of a house is 6300 sq. ft., 21 gallons of paint will be required for the work. If the cost of the paint is $2.35 per gallon, the material cost will be $49 35. The cost of labor for properly applying the paint should be figured at double the cost of the paint. To the total must be added cost of brushes, ladders, incidental materials, etc. It is readily seen, therefore, that the cost of the paint is a small part of the cost of painting, and for this reason only the best paint should be used in order to secure a job that will last for the longest time without repainting.

Why Good Paints Save Money

The property owner should remember that it is a very good business proposition to keep buildings of all types, especially dwellings and farm buildings,

well painted. By so doing, the value of a property increases at least 25%. If wooden structures are left bare and exposed, the surfaces become roughened and the wood is subjected to warping and cracking. When dampness enters such exposed wood, conditions become favorable for the action of destructive fungi and rotting may take place. Application of good paint, however, will preserve wood almost indefinitely. Striking illustrations of the truth of this statement are afforded by the condition of those well painted, century-old dwellings to be found throughout the original colonies of this country. Moreover, paints not only decorate and preserve wood, but they make it more resistant to fire. For this reason, the application of paints to shingled roofs is often advisable. For instance, prepared paints contain 60% to 70% of non-combustible, metallic or mineral pigments. When such paints are applied to shingles a very waterproof, semi-metallic film results. The film smooths the rough, fuzzy surface of the wood and prevents warping at the edges, thus doing away with the formation of pockets in which hot cinders, blown from a passing locomotive or carried from a neighboring fire, might lodge.

Paints for Various Surfaces

Painting the exterior or interior walls of a dwelling constitutes only a part of the many uses for paint. Painting metals of various kinds, varnishing and staining woodwork, and many other applications call for the use of an immense variety of paints and finishes. A list of many of these is shown in the chart.

PAINT FOR EXTERIOR SURFACES	Wood	Weatherboarded Dwellings, Churches and Factories, Fences and Wooden Structures.	Paint prepared on a Lead and Zinc Base. Preferably tinted. Class "A."
		Shingled Roofing and Siding.	Same as Class "A" or a Creosote Shingle Stain.
		Sheds, Barns and Outbuildings.	Same as Class "A" or Prepared Iron Oxide Paint.
		Porch Floors.	Colored Floor Paint containing Durable Varnish.
		Window Shutters.	Same as Class "A" or Chrome Green Shutter Paint.
	Metal	General Structural Iron and Steel Girders, Roofing, Siding, etc.	Rust Inhibitive Prepared Paint, Red Lead, Iron Oxide, etc. Class "B."
		Galvanized Iron.	Prime with 5% Water Solution of Copper Salt. Dry and apply Class "B" Paint.
		Tinned Roofing and Copper Flashing.	Clean all grease with Benzene. Apply Class "B" Paint.
	Stone	Brick Walls and Fronts.	Same as Class "A" or Prepared Red Iron Oxide Paint.
		Cement and Concrete Structures, Ball Parks, Pavilions, Stucco on Brick or Frame, Cement Tanks, Posts, Silos, Culverts, etc.	Prime with 25% Water solution of Zinc Sulphate (to neutralize alkali). Dry and apply Class "A" Paint or Cement Coater.
PAINT FOR INTERIOR SURFACES	Wood	General Trim, Stairways, Doors, Paneling.	Class "A" Paints finished with Enamel or Varnish.
		Doors, Paneling, Floors, etc. Transparent finish.	Fillers, Stains and Varnish as desired.
	Metal	Same as for Exterior Work.	Same as for Exterior Work.
	Stone	Ceilings and Walls of Portland Cement, Keene Cement or Sand Lime Plaster.	Alkali Neutralizing Primer, then Sanitary Flat Finish Oil Paint.
		Ceilings and Walls of Bath Rooms and Kitchens.	Alkali Neutralizing Primer, then Class "A" Paint, and Varnish or Washable Enamel.
		Cement Floors.	Alkali Neutralizing Primer, then Class "A" or Prepared Floor Paint.

An attractive bungalow of moderate cost. The detailed construction of this comfortable home is described in the following article.

Building a Bungalow. I

By Geo. M. Petersen

THE style of architecture best adapted for the homes of a great number of the American people, both for suburban and city use, is without doubt that commonly known as the bungalow.

The bungalow originally came from India and other Far Eastern countries where light construction and cool, well ventilated buildings are desirable. These bungalows are really garden-houses and are generally one story in height with large, roomy verandas. The bungalow was introduced in California and now is common to all parts of the United States, the construction varying, of course, with the different climatic conditions.

Because of the fact that the bungalow is primarily a garden-house, it is well to locate it on a large lot, on a slight elevation if possible, and surround it with trees and shrubs. For city use, the building should be set well back from the street, from 25 to 30 ft. at least, while in the country it should be located in the center of a large piece of ground or garden spot.

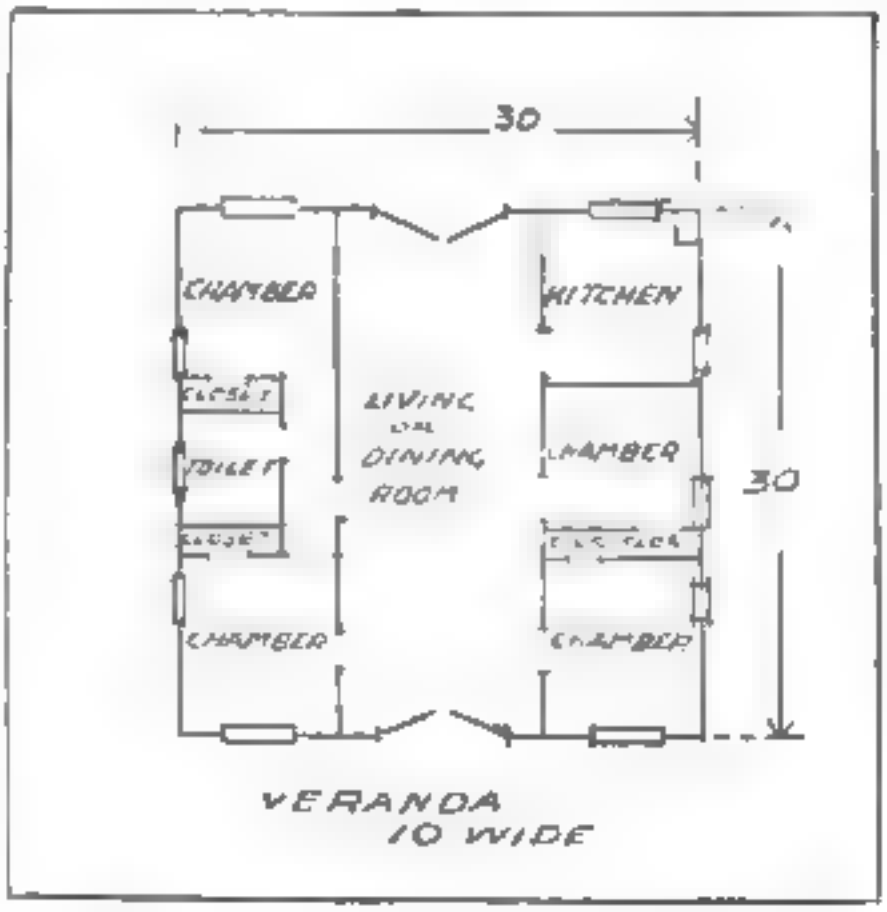


Fig. 1. Floor plan of an original Far Eastern bungalow

Due to the fact that a large number of architects, or at least so-called architects, have classed all of their architectural misfits under the heading of "bungalows" it is not uncommon to hear people express themselves as being unfavorable toward them. Others think they are only a fad and will soon go out of date, while others, and the writer is among the latter class, think that the bungalow is the most

desirable kind of dwelling in which to live; that it has come to stay and that, when properly planned and built, it is the most artistic and cosy home to be desired.

The advantages of the bungalow are

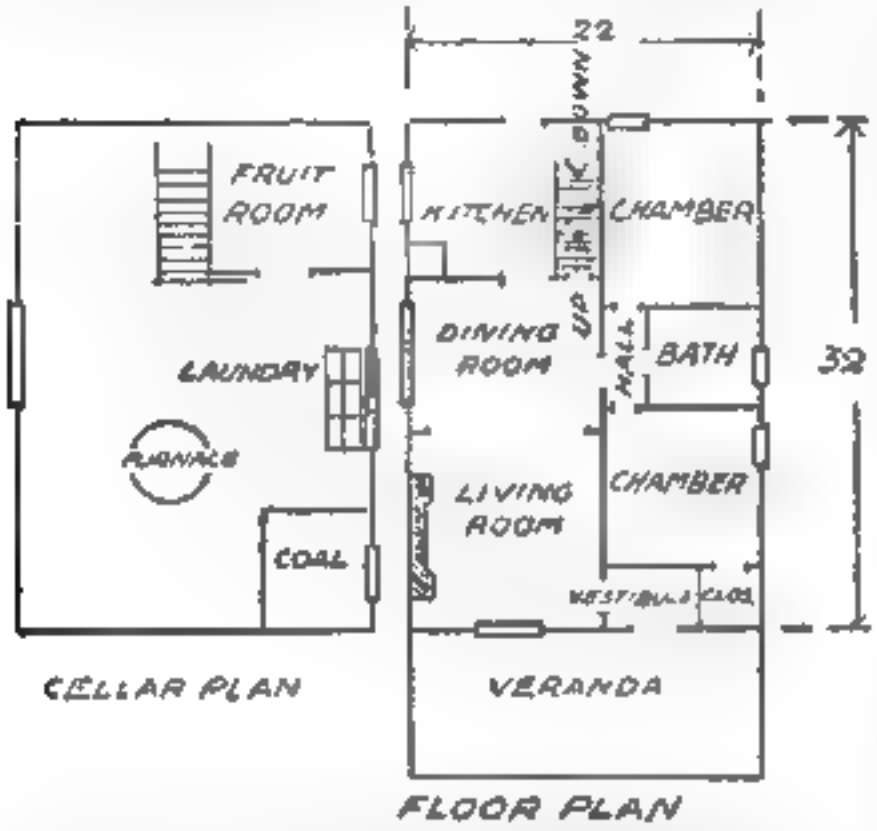


Fig. 2. A two-story city bungalow which was built for $1800

many, the one which appeals most strongly to the women being the fact that all of the work is on one floor and the continual running up and down stairs is done away with. This fact also helps to solve the servant problem in the suburban districts as many women who have never done their own housework in the old two-story houses have done away with their servants and are getting along without servants, through the handy arrangement of the bungalow. It is this same all-on-one-floor idea that is making two family flats so popular in the larger cities of the United States to-day. In short, the bungalow may be termed an efficient dwelling.

The size of the bungalow must naturally vary to meet the requirements, as to sleeping rooms, arrangement of rooms, etc., as well as to come within the finances of the builder, and at the same time look good on the lot.

The floor plan of an original Far Eastern bungalow is shown in Fig. 1. It has been remodeled for use in the colder climate of this country. It is a very simple affair, is decidedly cool and comfortable in the summer and remarkably warm and cosy in the winter. It can be readily heated at a small expense for fuel and is an ideal house for a small sum of money. This type of dwelling is particularly suitable for shore cottages, since it makes an ideal summer camp when built without a cellar and heated only with a large fireplace and the kitchen stove. This house can be built for the small sum of about $600, including ceiling the interior with wall board, or plaster, painting and plumbing. Of course this figure does not make any provision for hardwood trim, floors, tile bathrooms or anything of that nature, but is for the completed house, finished in a good substantial manner with good lasting materials.

The houses shown in Figs. 2 and 3 have been built by the writer for $1800 each, including cellar, furnace, fireplace, plumbing, laundry trays, electric lights, wall paper, shades, interior and exterior painting and, in fact, everything complete. These plans are strictly city homes in every sense of the word and are good enough for anyone, although they may be small for some families. A regular two-story bungalow is shown in

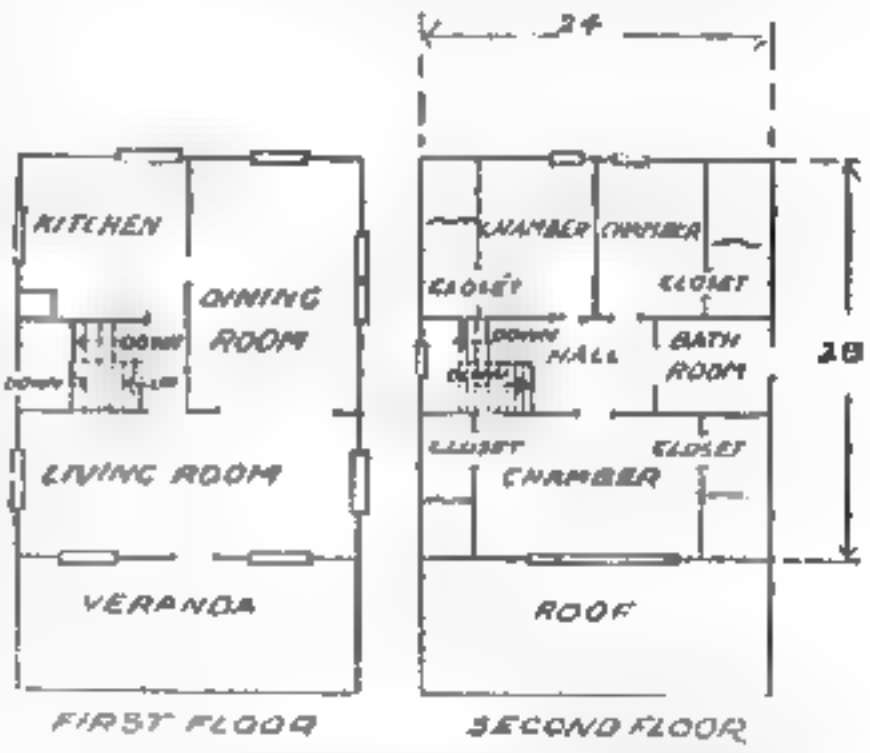


Fig. 3. This house, also, was built for $1800, including furnace and plumbing

Fig. 2, and, while it appears exceedingly small from the street, it is really very roomy. The one drawback to this type of bungalow lies in the fact that it is almost impossible to keep the sleeping rooms cool in the summer, due to the fact that the sun beats down on the roof all day long. In the one-story bungalow there is a small air-space and, in some, a good-sized attic, which acts

as an insulator against the heat. With the two-story type shown, however, there is no insulating space between the roof proper and the ceiling of the sleeping rooms except the thickness of the rafters, usually about 6 ins., and sometimes only 4 ins., which is not sufficient to protect the interior of the house from the outside heat. Of course this disadvantage may be overcome to a certain extent by covering the roof with asbestos shingles or with some other roofing material which will resist the heat, but unless the roof is well shaded by trees it will be almost impossible to keep the roof cool enough in the heat of summer to stop the heat from entering the second floor.

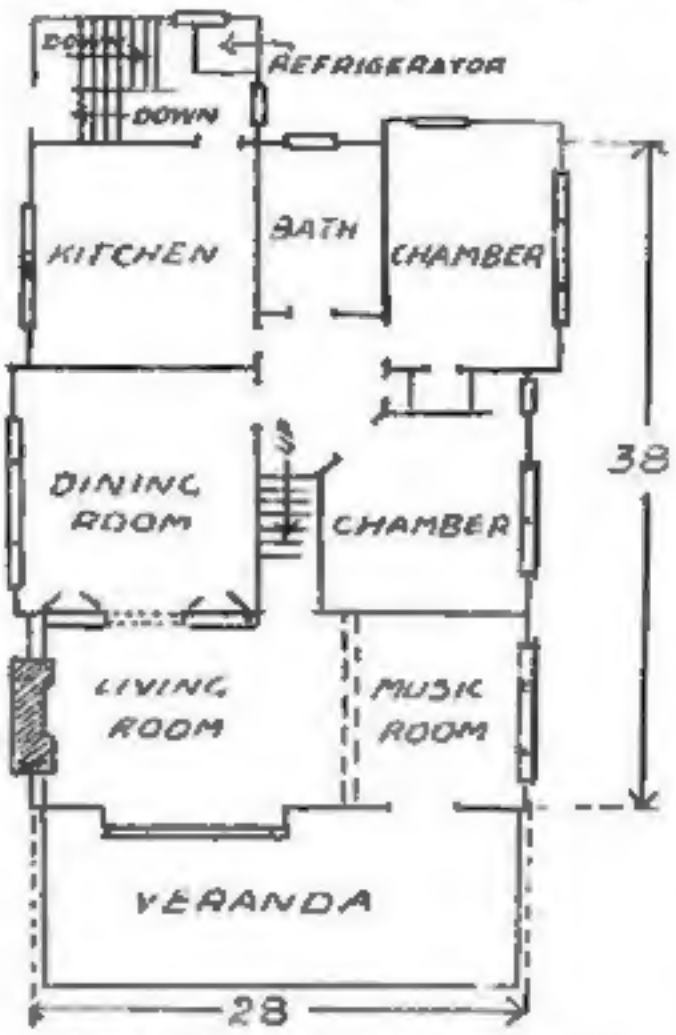


Fig. 4. Floor plan of a successful bungalow, costing $5,100 complete

One of the finest small bungalows which the writer has ever had the pleasure of erecting is illustrated in Fig. 4. While not costing as much as many others constructed by him, it is nevertheless a complete bungalow and for this reason it will be used as an example of what a modern bungalow should be. It was erected at a cost of $5100, complete, including a steam-heating plant and an automatic water-heater.

This bungalow is 28 ft. in width and 38 ft. in length as shown on the plan. The cellar has 7 ft. of headroom under the girder and 7 ft. 8 ins. of headroom under the joists, which not only obviates a continual bumping of one's head, but is of great assistance to the proper installation of the heating plant. The foundation walls extend 2 ft. above grade and are built of blue flint stone above grade and of limestone below. Limestone is used below, since flint "sweats" underground so that a flint stone wall is damp practically all of the time. Limestone, on the other hand, does not make a pleasing effect above ground, in the majority of cases, as it is inclined to be full of little holes and imperfections which stand out as glaring defects in the bright sunlight. The square bays which project on the east and west sides of the house are supported by large stone corbels in place of the ordinary wood brackets. The eaves overhang the house about 2 ft. 6 ins. and are pattern-cut rafter-ends, as shown in Fig. 5. The exterior is covered with gray-stained shingles which come very close to matching the gray of the massive stone chimney which extends up the outside of the building. The trim, or outside woodwork, other than the shingles, was painted white so that the color scheme of the building was merely stone gray and white. Bungalows, in general, should be painted with quiet color combinations such as the one just given; with two shades of the same color or with direct contrasts, a dark color such as green or brown is used for the body and white, pearl gray or some other direct contrast is used for the trim. Bungalows may be covered either with lap, bevel siding or shingles, although the latter are usually the most pleasing. Stucco or brick veneer may be used, although a bungalow loses a great deal

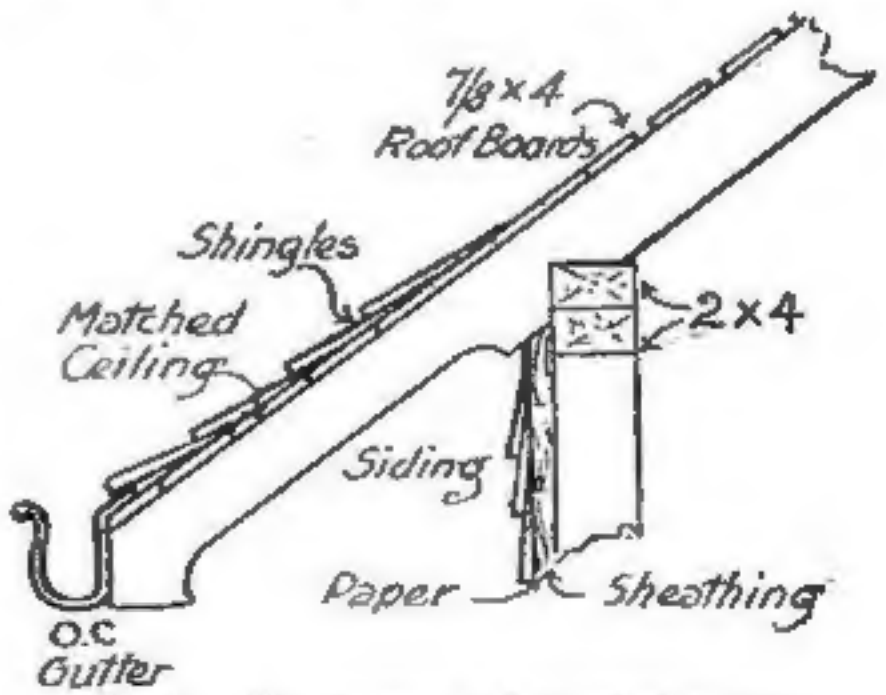


Fig. 5. The eaves of the bungalow are artistic in pattern with cut rafter-ends

of its cosy appearance when the exterior is of plaster or brick.

The interior of the house is finished complete with clear quarter-sawed white oak, including the kitchen wainscot, cupboards, etc. It may be well to state here that there is often considerable confusion in the owner's mind as to

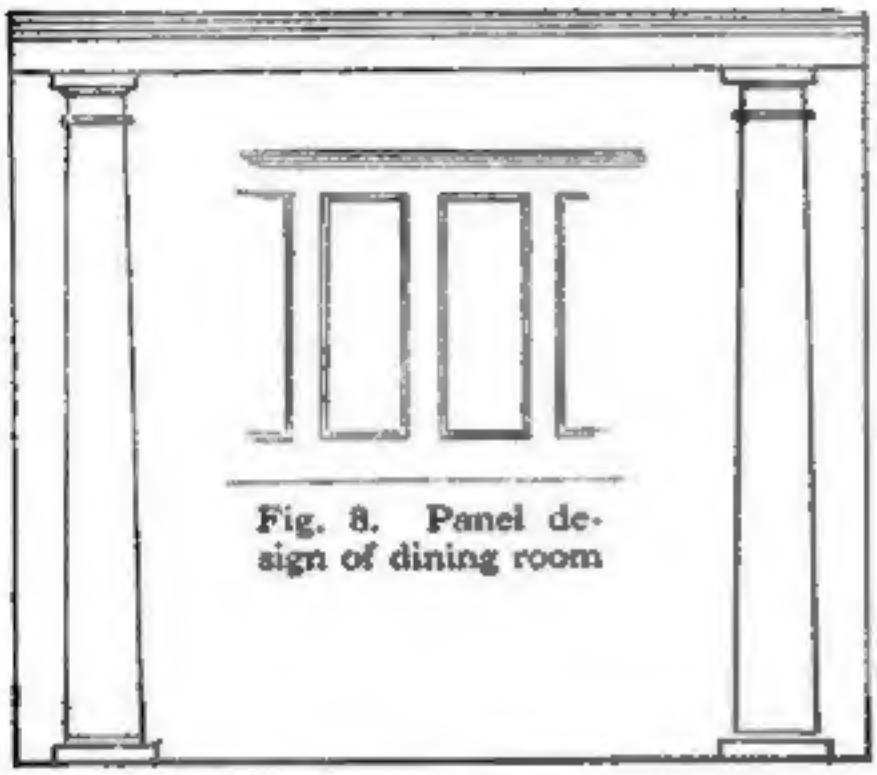


Fig. 8. Panel design of dining room

Fig. 6. Simple columns between music and living rooms

what is really the best grade of oak, since the grades are decidedly misleading. "Clear" oak is the best grade and "Number One" is second. "Select" is the third grade and perhaps the most commonly used, since it makes a very fair trim when finished. This third grade allows for small tight knots and pin worm holes, but is otherwise sound although the allowed percentage of lengths under two feet is very large, in the flooring grade.

Separating the music room from the living room is a very simple colonnade consisting of only two large columns, as shown in Fig. 6, while the living room and dining room are divided by a massive buttress having china cabinets on the dining room side and panels on the living room side, as shown in Fig. 7. The dining room itself is finished with a heavy beam-ceiling and a 5-foot 6-inch batten panel wainscot, the panels of which are made up of three plies of white oak veneer to prevent shrinking or warping. The panel design is shown in Fig. 8.

The doors throughout the house were all made specially for the job and are single-panel doors having a five-ply oak veneer panel.

In the rear hall, as marked on the plan, the linen closet was built with a clothes-chute underneath. The operation of this chute was decided on by the owner and it is certainly a good idea. The baseboard lifts up, the soiled clothes are dropped on the floor and pushed through the opening into the cellar box, from which they are taken directly to the laundry trays in the cellar.

The bathroom is finished in white tile and white enamel, with white enameled fixtures. The floor is laid of white hexagonal tile one inch in diameter, while the walls are wainscoted 5 ft. from the floor with 3 by 6-inch oblong glazed tile with tile cove and cap. The lavatory is an oval pedestal design and the closet is a low front-wash-out type. The tub is of standard enameled iron.

The average owner does not understand the grading of enameled ironware and therefore calls loudly for a "five-year guarantee" article. This is really an extravagance as a "two-year" guarantee is absolutely as good for the following reason; enameled ironware in general, and bathroom fixtures in particular, are known as "five-year," "two-year" and "non-guarantee" fixtures. This means that the best grade is guaranteed against any defect for the term of five years, the second grade for a term of two years, and the third grade for no time at all. The difference between the first and second grades, however, is very little, except in price.

(*To be concluded*)

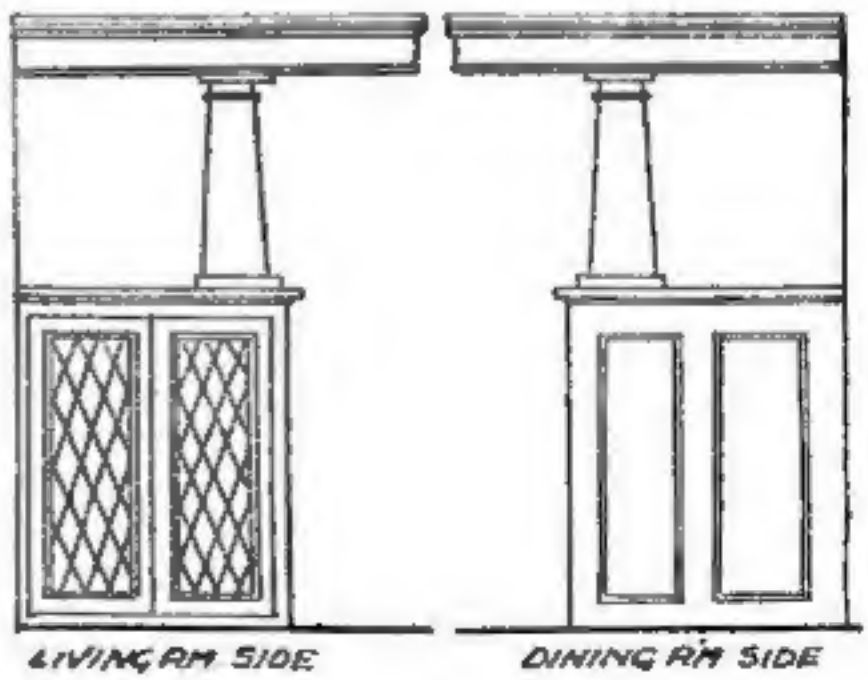


Fig. 7. Buttresses between dining room and living room

How I Made $22.50

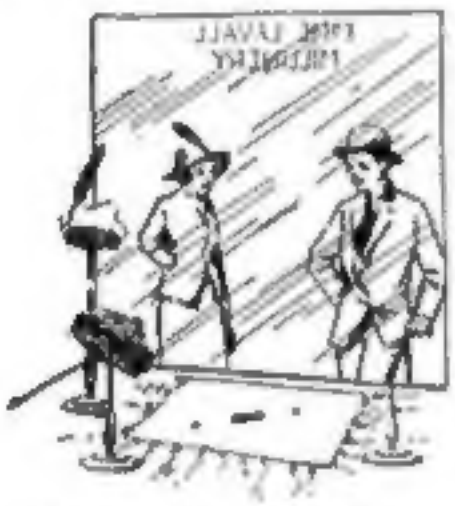
By Reading the

Popular Science Monthly

ON an investment of seventy-five cents I realized a profit of twenty-two dollars and fifty cents, or three thousand per cent.

It was the POPULAR SCIENCE MONTHLY that paid the profit.

I have been a constant reader of POPULAR SCIENCE for some time. Often I wondered who wrote the interesting articles which I read. One night I was in my workshop etching glass by a method described in a previous issue. The work was halted by the absolute necessity of having perfectly clean glass to work upon. Finally I hit upon alcohol and powdered chalk. The result was all I hoped for.



The number of the Popular Science Monthly containing the article on Novel Window Attractions was rented for six dollars and a half

After finishing the work I sat down for a smoke, thoroughly satisfied with myself—as we all are after a job well done. Picking up the current issue of "our" magazine I prepared myself for an enjoyable evening. Suddenly I came across a small reading notice at the bottom of a page—something that I had not seen before. It read:

"*Ideas submitted to this department are paid for at space rates when published.*"

That sounded good, but what could I sell? I have it! That alcohol-chalk stunt—it's good, dustless, and practical. So I sent in an article on a "Dustless Window Cleaner." It was accepted and paid for. I've written a few articles since then that paid more.

While talking to a local merchant one day, he told me what he paid a Boston man for window attractions. I thought it over that night. I brought out my bunch of POPULAR SCIENCE MONTHLIES and went through the index of each for window attractions. Luck! I know what the word means now.

Do any of you remember "Novel Window Attractions" in the January, 1915, issue, page 81? Look it up. It will pay you to do so. I rented the magazine to my friend, the local merchant, for one dollar per night, first two nights, fifty cents each night thereafter. He had it four nights. Another merchant paid me for five nights more.

"Magic Mirror for Show Windows" (December, 1914, page 668) paid me in rent the same terms, five and one-half dollars.

"Colored Lights in Window Display" (April, 1914, page 1467) paid me in rent from a florist, two nights, four dollars.

The most prominent dye house in town paid me a dollar for "A Facetious Dyer's Sign" (September, 1914, page 238).

I made up about a pint of "Acid Ink Eraser" (July, 1915, page 89), and sold five two-ounce bottles at twenty-five cents a bottle.

I wish to take this opportunity to thank the POPULAR SCIENCE MONTHLY, the editors and contributors. I have itemized what I have made. Study the figures; look up articles; and then—"Go Thou and do likewise."

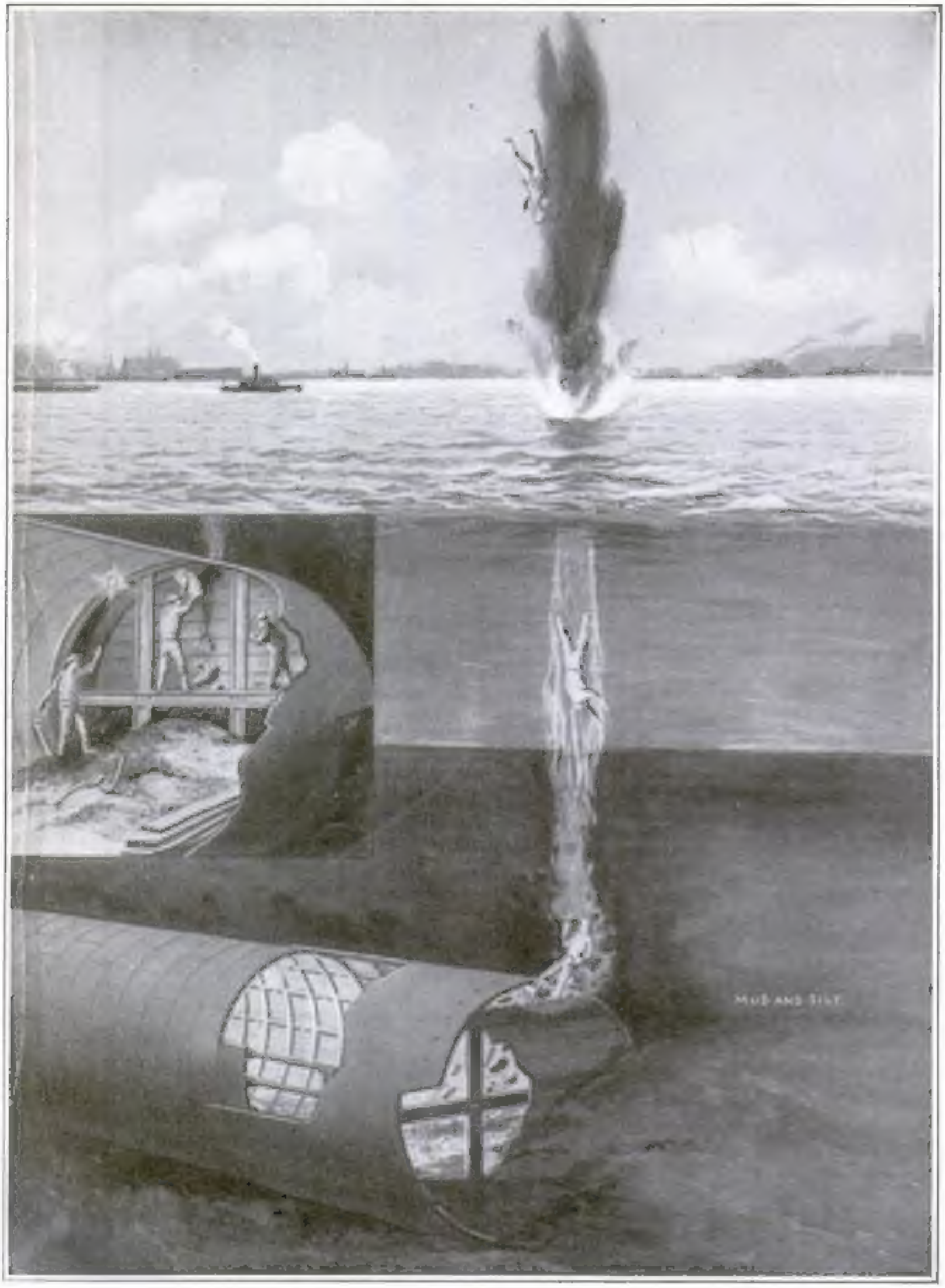
"Colored Lights in Window Display" paid me in rent (for the magazine) from a florist, two nights, four dollars

A dye house paid a dollar for the idea of a "Facetious Dyer's Sign

Received:

Articles, Popular Science Monthly, space rates		$15.00
Rent, "Novel Window Attractions"		6.50
" "*Magic Mirror*"		5.50
" "*Colored Lights*"		4.00
Information, "Dyer's Sign"		1.00
Sale of "Ink Eraser"		1.25
Estimated Material and Labor	$10.00	
Cost of magazines from from which articles were taken	.75	
	$10.75	$33.25
		10.75
Profit on Investment		$22.50

L. E. FETTER,
591 Middle St.,
Portsmouth, N. H.



Three men were blown through twenty-seven feet of river mud, twenty-five feet of water and twenty feet into the air on top of a geyser of mud and foam while engaged in excavating the bed of the East River, New York city, for the building of a new subway. They were working in what is known as a shield, which is pushed forward foot by foot as the workmen progress. Compressed air prevents the water from rushing into the shield. The great pressure of the air forced the three men one after the other through a hole in the river bed. One of the men, the first to be ejected into the river, survived